TELEPHONE ENGINEER

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HIGH SPEED TOLL SERVICE PAYS

The other day we happened to be in the office of an executive of a large corporation in Chicago. While we were there he placed a call via "Long Distance" for the New York office of the company. In three minutes and twenty seconds, the Chicago operator reported that the called party had left the office for the day. A second call was made a few minutes later for another party and in five minutes and thirty seconds the connection was established.

These were not special calls, but were put in in the regular order of the day's business and no special attention was asked or given by the telephone company. In effect, the service was almost as rapid as if the executive had pushed the call button on his desk and when the office boy reported, had said: "Ask Mr. X. to come to my office." Mr. X could scarcely have reached the office in less time than the New York call was completed.

We were sufficiently impressed with this performance of the long distance service that we spoke of the situation to officials of the Long Lines Department of the Bell System and from them we learned that there had been an appreciable increase in traffic since the new high speed service had been inaugurated. While we can not quote them officially, we gathered the impression that if the increase in traffic continues, the new toll cable which has just been finished will soon be insufficient to carry the traffic, and relief in the form of additional cables between certain points will become necessary.

The experience of the Bell System in this case brings out more forcibly than ever, the fact that the quickest and most certain way of increasing toll revenue is to provide a faster, more accurate toll service.

A WONDERFUL ENGINEERING OPPORTUNITY

Many telephone engineers in the United States will look with a bit of envy at the opportunity which their fellows in Spain will have for the development of a national telephone system. The Spanish project is more than a modernization of an existing telephone plant. It is, in fact, a project involving the construction of an entirely new plant and, as such, offers a wonderful opening for the design of a complete system, using most modern methods, and unhampered by the necessity of utilizing large portions of existing plant which, while not of the latest type, has not outlived its usefulness.

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WHY NOT AN EMPLOYE BENEFIT PLAN?

One of the delicate problems of the transfer of ownership of a telephone property, or the consolidation of two systems, is the adjustment of the relations of the employes of the system which is transferred or absorbed. Bell officials have stated that one of the difficulties of releasing portions of their property to Independent operation is that of caring for the rights and benefits that employes have earned by years of service.

It frequently is a real hardship for an old employe to see the property upon which he has spent the best years of his life transferred to new ownership and to find that he is faced with accepting a place with the new owners with a loss of seniority and pension rights; or, as an alternative, in order to preserve those rights, is faced with a transfer to some other point, still operated by the old employer, away from home and family connections.

This applies, not alone to Bell employes where Bell property is sold to Independent companies, but also to Independent employes where the Bell absorbs Independent systems, with the exception that few of the latter lose sickness and death benefits and pension rights, since only a few of the larger of the Independent companies have established such benefits.

The question naturally arises as to why such benefit plans have not been established more widely by Independent companies. It is true that most of the companies,

smaller than Class A, scarcely could find a workable plan within their own organization, but a way certainly can be worked out through co-operation or through insurance channels. There now are many insurance companies writing group policies on the health and life of industrial employes. There seems to be no reason why an annuity feature upon retirement of the employe could not be worked into the scheme and the major benefits available under the Bell benefit plans thus obtained for Independents.

The trouble seems to be that Independent companies have not been sold on the idea of establishing benefits. Once they are sold the idea, the way of establishing such a benefit plan soon will become apparent. Years ago, it was impossible for a telephone company to get public liability insurance. There was a demand for such coverage and soon an organization entered the field to write this class of insurance. Today, there are a large number of companies in the field who are writing public liability insurance, not alone on telephone companies but on every class of business. It is to be expected that the same would be true of any class of insurance for which there is sufficient demand.

This problem is not new. The Pennsylvania Association has given it much consideration and it was discussed at some length at the National Convention of the United States Independent Telephone Association a year ago, but no progress seems to have been made. If a group of progressive Independent telephone companies will come forward and say that they are ready to go into the matter, as soon as a workable plan is presented, the plan soon will be forthcoming, or our powers of prophecy are sadly lacking.

NEW POLES AT THE CURVES.

The urge to "step on the gas to see what the old boat will do" is particularly strong when the view over the radiator cap is a smooth, level piece of pavement that leads the eye into the distance. Every one who drives feels the urge in some degree whether his car be the humble vehicle of the masses frequently designated as a flivver or be a purring monster.

Our own personal response was normal, a few days since, when a particularly inviting bit of highway loomed up in front of our modest equipage and almost before we knew it, the legal limit which the law places upon our rate of progress had suffered a slight fracture—and this is a state which is by no means backward in recognizing that things move rapidly in this modern age.

All ancient truths have not been abrogated by modern progress and one that is still as true as ever is the aphorism which, paraphrased in modern language, says that it is a long road that has no curves. We swung a bit widely when we came to the curve on our own road and the object that engaged our immediate attention was a very new telephone pole on the outside of the curve. Fortunately for ourselves and perhaps for the pole, the margin was sufficient and we proceeded on our way at a more slow and thoughtful pace.

Like all of our craft, we had unconsciously been watching the line as we traveled along. It was a good line, well weathered from several years' service but good for many more.

A few new poles had been placed in the line and as we followed the road that now curved its way along the foot of the hills overlooking one of our great watercourses, it was finally impressed upon us that there was a definite relation between the new poles and the curves of the road.

A closer observation showed that at nearly every curve where the line was on the outside of the curve, the first pole beyond the curve had been renewed and our own experience of a few miles back gave us the reason. It is difficult to estimate the aggregate amount of damage that is done yearly by collisions of automobiles with the telephone poles along the highways. In a great majority of cases, the fault is clearly with the driver and wherever possible damages should be collected. In this one item there is a considerable amount of expense which should be placed on the persons responsible for it, rather than loaded upon the general public.

HIGHER CHARGES FOR DESK SETS.

In issuing its general order, permitting telephone companies with rates not exceeding certain maxima to establish an extra charge of 25 cents per month for desk sets, the Oklahoma Corporation Commission has recognized the increased cost of the desk set over the wall set and has applied the principle that those who demand a more costly service should bear the cost. The order is permissive rather than mandatory, but it is to be expected that practically all telephone companies in the state will avail themselves of the opportunity to place the charge in force. Other states would do well to follow Oklahoma's lead.

CHRISTMAS GREETINGS.

As the Holiday Season approaches, we again welcome the opportunity to extend a pleasant word to the ever-widening circle of friends and readers of TELEPHONE ENGINEER. It, obviously, is impossible to send individual and personal greetings to such large numbers, but individual and personal greetings can not be more heartfelt than those which we extend to you through these columns when we address to you these fine, old-fashioned salutations: "Merry Christmas" and "Happy New Year."

Do You Need More Revenue?

A Way to Get It Is to Develop the Use of Existing Facilities to Their Maximum Capacity—How One Company Did It Systematically and Successfully

By H. F. McCULLA,
Commercial Engineer, Lincoln Telephone & Telegraph Co.

During the construction period of a new property or plant we are usually busily concerned with the details of investment requirements.

The raising of capital for the enterprise may be effected in one or more of many orthodox ways. The use of personal funds, the sale of stocks or bonds or both, or the pledging of other property as security may be the means of raising the required capital.

The task may or may not be a difficult one, but considering it as accomplished we are confronted with the necessity of producing sufficient revenue to return to the investor a reasonable interest or dividend rate on his investment. In addition to the interest and dividend requirements other fixed charges such as depreciation, taxes and insurance, must be earned.

The serious consideration of these fixed charges necessary in the operation of a going business concern gives rise to the equally important problem of producing sufficient revenue to pay not only these fixed charges but also to pay all operating expenses.

It is rather far-fetched to assume that any individual or group of individuals would construct a telephone property without first having carefully considered the ability of the completed property to produce enough revenue to perpetuate its existence as a going concern. It is fair to assume, however, that numerous telephone properties have been constructed by well intentioned and financially wise men who through lack of definite knowledge of the operating cost of such a property have failed to make revenue and expense meet. This lack of success may also be due to the inability of human minds to foresee radical economic changes which so seriously affect expenses or revenues or both as to result in operating and fixed costs far in excess of reasonable revenue expectancies.

No matter what the cause may be, it is imperative that such unexpected added costs be met if the property is to be placed in service and continued as a going property.

For our purpose we will assume that a telephone property has been built on a sound financial basis, has been placed in service and that for a period of several years it has produced sufficient revenue to continue operations on a very satisfactory financial basis. Due to post war conditions the use of all telephone service has been curtailed and we find ourselves confronted with the necessity of producing more net revenue.

Three mediums of obtaining the desired answer are available: viz., decreased expenses, increased revenue due to added service sales, or a general increase in telephone rates.

Serious and successful efforts have been made to decrease expenses, but the needed increase in net revenue has not been produced. The next logical medium to employ is that of a further development of the revenue producing accounts. In order to realize the largest possible development at the least expenditure a "Plan of Revenue Development" has been worked out. It is this "Plan of Revenue Development" that gives the motive for writing this article. It is not only an interesting plan to consider but one which has been tried and found effective in producing results. This hypothetical case of the experiences of an eastern telephone company in their revenue development work will perhaps be more interesting when it is stated that the case after all is not a hypothesis but an honest-to-goodness reality.

The "Plan of Revenue Development" as worked out by the telephone company of which we write was very comprehensive as it included a plan for the development of every revenue account. A concise but complete explanation of that portion of the plan devoted to the station development work follows. A later article will deal with that portion of the plan devoted to the development of the toll and miscellaneous revenue accounts.

In evolving the plan it was thought best to consider each of the one hundred and twenty exchanges of the telephone company as separate units and to form the plan to fit all exchanges regardless of size. Proceeding on this basis each exchange was considered as consisting of two distinct areas, viz.: a city area and a farm area. For each area a map was prepared on which were indicated in code the different types of prospects for telephone service. The map prepared for the city area was of necessity more detailed than the farm area map because of the variety of classes or types of subscriber prospects. Both area maps were prepared in duplicate by the exchange manager, who retained one copy of each and forwarded the other copy of each to his district manager.

The exchange managers were supplied with a quantity of forms called "Station Development Report," Fig. 1, with instructions to prepare the report in triplicate each week. On the report was listed the detailed information of his station development activities of the week. One copy of the triplicate report was retained by the exchange manager, one copy forwarded to his district manager, and one

L. T. & T. Co. Form 1-21

WEEKLY STATION DEVELOPEMENT REPORT

EXCHANGE Raymond DATE April 29 1924

PROSPECT'S NAME	"C" or "F"	ADDRESS	"CONTRACT"	EXPLAIN IN DETAIL STATUS OF PROSPECT
E. Hawkinson	"F"	Raymond	No	A bachelor and thinks he has no use for a phone

EMPLOYE MAKING SOLICITATION

DEPARTMENT

Execute in triplicate at Local Office. Forward copies to District Manager and Commercial Superintendent

*Indicate "C" for city and "F" for farm.

**State "Yes" or "No" in "Contract" column, indicating whether or not contract was obtained

Fig. 1.

forwarded to the commercial superintendent.

At the time of preparing the weekly report the exchange manager would correct his area maps, bringing them up-to-date by changing the code of new subscribers obtained from that of a prospect to that of a subscriber. Upon receipt of this weekly report the district manager would correct his exchange area maps in the same manner.

The exchange manager had been instructed to divide the total number of prospects in his exchange area into twelve equal groups soliciting one group each week and thus completing his solicitation work in twelve weeks.

Through the medium of the weekly station development report the district manager was able to check very closely the activities of his exchange manager.

During the development work new prospects would of course locate in the different exchange areas. These new prospects were immediately classified and spotted on the proper area map. Information necessary for correction of the district manager's map was furnished on a small map attached to the station development report.

Records and reports were purposely kept at a minimum because the entire development work was done by exchange managers already heavily loaded with exchange duties and responsibilities.

But one report was issued to the field by the general office, that report being a weekly summary of development work done and results obtained in each exchange. Exchanges of comparable size were grouped on the report for the purpose of injecting into the work a spirit

RAYMOND		4-29-24
	E. Hawkinson Farm	
	A bachelor and thinks he has no use for a phone.	
7-26-24	Party has decided he does not need telephone. Has no family, lives alone.	
8-22-25	Says he does not need telephone.	

Fig. 2.

The copy of the weekly report received in the office of the commercial superintendent was used as the basis of a card record of prospects. As the name and location of the prospective subscribers were reported on the weekly report by the exchange manager a card record of each was made (Fig. 2). All repeat solicitations were recorded on the prospect's card. Whenever the prospect was converted to a subscriber by the exchange manager his card was removed from file and destroyed as it was of no further use.

At the end of the twelve weeks' period a complete card record of all prospective subscribers still remaining in each of the one hundred twenty exchange areas was in the office of the commercial superintendent, compiled as previously explained from information submitted from the field through the station development report. This complete record was used as the basis of further development work. To bring the records of the exchange, district, and general office, into absolute agreement the city area and farm area maps of each exchange, showing as they did the code and location of each prospect, were checked against the card record.

of friendly competition.

The tremendous success of this simple station development plan served to bring home most forcibly to the officials of this particular telephone company two very pertinent facts:- First, the point of telephone saturation has not been reached nor is it apt to be reached for some time to come; second, no one can safely predict the capacity of the personnel of a loyal organization for constructive work until that capacity is called into play in pursuit of a definite and worth while objective.

Pacific Bell Plans Big Expansion Campaign

San Francisco, Cal.—More than $1,000,000 is to be spent by the Pacific Telephone and Telegraph Company to increase its long distance lines that run into the San Joaquin and Sacramento valleys. The largest and longest cable in the West will be placed between San Francisco and Sacramento. To provide additional long distance circuits between points in northern California and Portland, an expenditure of $700,000 will be made, it is said.

Want a 50-50 Split

Independents Ask Bell to Give Up as Much as Latter Takes

Pursuant to a resolution adopted by the Board of Directors of the United States Independent Telephone Association, October 15, 1925, the executive committee of the association met at Chicago November 13 with Vice-President E. K. Hall of the American Telephone and Telegraph Co. for a conference regarding a procedure by which, for every purchase by the Bell company of an Independent telephone property, there would be a corresponding relinquishment by the Bell company, this position having been taken by the directors.

The executive committee reported to the directors at a meeting held at Chicago, December 4, that, as the result of the November 13 conference, agreement on one proposition could be reported that the Bell companies stood firmly with the Independent Association in confirming that two strong groups in the telephone industry were essential; and that, on the question of arranging a procedure for relinquishments to offset sales, progress had been made but no conclusion had been reached.

After an afternoon devoted to discussion of the problems presented and a possible solution, the directors asked the executive committee to arrange for further conferences at which the principle of relinquishments should be again put forward and an agreement on procedure reached, if possible.

The names of the association's executive committee, who are thus responsible for the negotiations, are: G. W. Robinson, president Tri State Telephone and Telegraph Co., St. Paul, Minn.; W. H. Bryant, vice-president and general manager Home Telephone Co., Mobile, Ala.; E. C. Blomeyer, vice-president Theodore Gary and Co., Kansas City, Mo.; H. L. Beyer, of Chicago; Frank A. Knapp, president of the Knapp Properties, Bellevue, O.; R. E. Mattison, general manager Lincoln Telephone and Telegraph Company, Lincoln, Neb.; F. B. MacKinnon, president United States Independent Telephone Association, ex-officio chairman of executive committee.

Frank Eldridge Side Steps Slash of Grim Reaper

Chicago, Ill.—Frank Eldridge, general sales representative of the French Battery Co., is recovering from a hard siege of pneumonia. Eldridge formerly was an athlete of note, and needed all of his magnificent physique to pull him through this illness. However, Frank wasn't the only one who suffered during his session in bed. Three mailmen got hernias dragging in letters from his friends.

Hints on Wire Stringing

"Know-How" of Stringing Wire Is Not All in the Specifications — Here Are Suggestions for Planning and Performance to Keep Every Man Busy at All Times

By J. M. WALSHE

The process of stringing wire involves some work not usually described in specification.

There are a number of conditions upon which the nature of the work depends. The number of circuits to be erected; whether the line is old or new; the position of the existing circuits on the crossarms; the positions that the new circuits are to occupy; the location of the line, in lane or street, open country, or along railway; proximity of other lines; additional guying necessary before line is erected; existing circuits to be moved or removed; the size and material of the wire; the distance to be erected; the distance from the source of supply of materials; the provision of board, lodging, stabling, storage and gasoline, where motor vehicles are used along the line.

Where the new construction is a continuation of existing lines the transposition scheme must follow in the correct order.

Stringing One Circuit in Open Country

The simplest case is where the pole pair is to be erected on a new line of poles which have to be guyed at the same time; the length of the line being several miles, along a country road, guyed each way with line guys every mile and transposed every "A" pole which will be every eighteenth pole, on a line of thirty-six poles to the mile. The material will be shipped by railway to points near the line at about eight-mile intervals, so that at the start eight miles of material will be on hand.

In suitable places a light truck can be used and at the rear two pay-out reels are mounted on a piece of plank. The truck is loaded with material and the gang consisting of three linemen and truck driver start for the pole line. A tool box and the following tools have been provided and the men are equipped with spurs, pliers, connectors, wrench, tool belt and safety strap:

1 Tool box.
2 Pay out reels.
10 Buffalo grips.
2 Sets double sheave blocks, half inch.
200 Feet half-inch rope.
2 Hand axes.
1 Set stencils with brush.
1 Can black paint.
1 Single pulley for evener.
50 Feet half-inch rope for evener and connecting grips.

On arrival at the first pole one man unwraps the wire and puts it on the pay out reels while the second man is collecting the material he requires for guying at that place. The third man makes up the blocks and grips terminating the rope on the blocks, on the evener grips and on the pairs of grips used to hold the wire until tied. The driver will open the barrels of insulators and make himself useful to whoever wants him at the moment. The wires from the reels are now carried up the pole and dead ended on the insulators. One man is left with the tools and material for guying and a mile of tie wires. The truck then starts off along the line, keeping close to the pole line, the wire running off the reels. At the second pole the wire is carried up the pole and hung over the cross arm or brackets; each wire is kept separate on the place it will occupy. At this pole and at each succeeding pole two insulators are put off. One man is riding on the truck minding the reels and throwing out insulators at each pole, the other is following behind putting up the wire and insulators.

At the ninth pole the first transposition occurs and the truck has to stop to stencil the pole and take the coils of wire off the reels and reverse them.

How the Transposition Is Made

Before proceeding with the subject, a little fuller explanation of how the transposition is made will be in order.

The specifications probably call for the wire on the right to be carried over the other and continued on the left. At the transposition insulator the wire on the right is tied in the top groove of the insulator past which it continues on the left. To arrange the wire for this take off the coil of wire on the left reel and put it in the truck, then take off the coil of wire on the right reel and put it on the left reel, then take up the coil in the truck and put it on the empty reel. It will not matter in which direction you look along the line to do this; you can face forward or backward, but face one way till it is completed.

Where crossarms are erected and the single pin type of transposition is used it will be necessary to remove the pin where the transposition insulator is to be installed and substitute a 9-inch pin, as this is required for two-piece insulators. The lineman climbs the pole and knocks the 8-inch pin out with a through bolt and hand-axe, the 9-inch pin is then driven in and nailed.

The next stop will be at the eighteenth pole which has to be stenciled. Although no transposition will occur in this circuit at that point, at about this point it will be found that the wire on the pay out reels is getting low.

While the linesman is stenciling the pole the truck driver may unwrap two more coils of wire and put them on the reels, putting the few turns that remain from the last coils on top. If iron wire is being strung it is convenient to cut the few remaining turns of the last coils off and splice the new coils on. This saves a stop and the short ends are convenient for the wire.

Proceeding as before, another transposition is thrown in at pole twenty-seven, the top pin is changed, the pole stenciled and the truck moves on, stopping next at the one mile mark where the poles on either side of the crossroad are to be guyed. The evener pulley is now attached to the rear of the truck and the grips put on their respective wires.

Next the lineman will proceed to guy the poles. As this is almost all covered by the specifications, it need not be described here. In the mean time the following lineman has arrived and put up the wire.

The truck now moves forward, pulling the slack out of the wires. The lineman has guyed the pole on the far side of the road first, so that when the slack is all pulled out, a rope two feet long with a grip at each end is put round the pole and the grips are put on the wires. The number of inches of sag allowed in the specifications for that length of span is easily checked by the man waiting at the top of the pole to put the grips on. The third man seeing the wires pulled up begins to tie in the line. He can carry his tools tied together, leaving them at the foot of each pole. He climbs the backs of the poles as do the others, because they are easier than the faces, chiefly for the reason that the strain on the arms is less. The tie is made according to specifications. When tying in a transposition the bottom wire is tied first then the top wire and a look is taken back on the line to see that the wires are clear.

Each Man Is Kept Busy at All Times

It will be noticed that the work can be arranged so that no man is kept waiting till another has finished his part. For example, the insulators can be carried up the poles at the time the wire is put up or they can be left for the man who is to tie in. In the case of the first mile the insulators and the transposition pins should be left for the man tying in, as his guying will usually be completed before the wire is pulled tight and ready to tie in. Afterwards he will be kept busy tying.

The men should also change duties with each other to avoid any feeling of preference or superiority.

It is an advantage to have a knowledge of where board can be obtained along the route, and where lodging is necessary and possible, so that it is advisable to employ on the wire gang either a lineman or truck driver, a man who was present when the pole line was erected.

More Men Needed in Heavy Work

When a heavy route is to be strung many more men can be employed and large quantities of material are used. This requires more organization and supervision. Calculations have to be made and a plan of operation decided upon. Complete information of the conditions to be met must be available for each portion of the line.

Not only physical but phantom transpositions are to be thrown in while stringing the wire, and it will be remembered that there are four types of them.

To string twenty circuits on four crossarms it will be convenient to use two trucks with four pay out reels mounted on each. If it is possible to drive on each side of the pole line the work is facilitated.

If arrangements are made to have the wire, insulators and other material delivered at each mile, the wire trucks will have to carry only half a ton of wire at a load, one mile for each reel.

Insulators will be distributed from a separate truck, and the poles may be stenciled and transposition brackets and pins installed by the lineman it carries.

The first wire truck will begin by stringing circuits eighteen and thirteen (pin positions 35 and 36, 25 and 26) if they are to be phantomed and at each pole the field wires are taken over the top of the pole and put on the outside of the pins where they belong. A phantom transposition of circuits eighteen and thirteen is made on two poles. Some specifications demand the rotation of side circuits to be phantomed opposite the direction of the physical transposition.

Physical transpositions are easily made by reversing the wire on the pay out reels and placing both wires on one side of the pole according to the pin position to be occupied, which will depend on the direction in which the line is being transposed. When the wire truck is going in the direction in which the line is to be transposed circuits eighteen and thirteen are transposed with each other as follows:

On arrival at the pole next before the transposition pole, if single pin transpositions are used, side circuit thirteen is placed on the field side of the pole and side circuit eighteen placed on the road side. This is also conditional upon the pole line being located on the south side of the road and physical transpositions being right over left or counter clockwise and phantom transpositions being left over right that is clockwise in direction of rotation. Next, physical transpositions are thrown in if the type of phantom transposition calls for them in either or both side circuits.

At the transposition pole, side circuits remain one on each side as at previous pole, but side circuit eighteen moves up to the arm above and side circuit thirteen moves down to fourth arm. Being on opposite sides of the pole there is no danger of a cross. On the next pole they carry on, one wire of each side circuit, each side of the pole as before. All that now remains to do is to pull and tie it in.

The second wire truck can follow transposing side circuits three and eight (pins 5 and 6, 15 and 16) in the same way as thirteen and eighteen. In straight open sections without obstructions it is convenient to pull a mile at a time. Hard drawn copper as small as one hundred and four millimeters diameter will stand this.

The procedure now will depend on how many miles are to be strung and whether it is possible to drive on both sides of the line.

In the latter case one wire truck can now load up wire and return stringing circuits sixteen and seventeen (pins 31 and 32, 33 and 34) the process of throwing in phantom transpositions in this case is merely following the method used in physical transpositions, taking care to get the type as specified.

The truck can now go back and forth until all circuits are up for a mile.

Rods May Be Used for Place Wires in Cross Arms

Where the new type of construction is used and the poles are quite short all the circuits can be put up from the ground by means of a rod. A convenient arrangement is to have four hooks on the rod and to put a wire in each, the inside wire at the top, then lifting the rod high enough to place the wire over the outside pin a downward and inward movement of the top of the rod places each wire in its place.

It is next necessary to stretch these wires. It is supposed that the guys have been securely anchored. An evener is prepared which will pull four circuits at once. It will consist of four single pulley eveners of 20 feet of 5/8-inch rope spliced to the eight grips. Two lengths of 3/4-inch rope of 30 feet are passed through two 3/4-inch single pulleys and 30 feet of 1-inch rope with a 1-inch single pulley connected to the last two pulleys. The pull is made on the last single 1-inch pulley.

This sounds like a complicated arrangement but it is only seven single pulleys and some rope and grips. The pull is made by a truck or team of horses with a set of double blocks to take inch and a quarter rope. A wire sling is put around the butt of the next pole to pull against, as in pulling messenger. The first circuits to pull are circuits three, eight, thirteen and eighteen. Holding grips are put on these and then the outside pairs, sixteen, seventeen, nineteen and twenty, then the third crossarm, then the second and lastly the top.

When all are pulled have a man check it up before word is given to tie it in. If any part has to be pulled over again, a man may be stationed up a pole at the center to give an O. K. to each pull and avoid doing it over twice. This is always a wise precaution for the first mile.

During these operations the wire trucks have been busy and the next mile is partly run out.

Stringing on Congested Routes

Stringing wire on a congested route where there are high tension power lines, feeders, service wires, trolley wires, telegraph wires and radio antennae is a much more difficult operation. It is seldom possible to use wire trucks to run the wire out and their use will now be to pull on a rope.

The pay-out reels are located before the first pole and the wires pass through guides. One of the old wire wagons with ten pay-out reels is best for this purpose.

There may be one or two running boards used with one or two draw ropes respectively, and they may both be pulled together. A running board which has ten snaps, such as are used with rope halters, can be used if ten wires are to be strung under existing wires. At each pole half the wires are taken off, passed around the pole and snapped on again. The wire has a loop twisted in its end for this purpose. When the top arm is to be strung no difficulty will be met, but if it is already strung and in use, the lower arms will present more problems.

A steel rope about 50 feet longer than the section it is proposed to pull, is threaded through and left on top of the crossarm to be strung. The running board is fastened to this rope. Men are stationed up each pole and as the running board reaches them it is lifted over the crossarm. A signal is then made to stop

the rope and the wires are carried round the pole, one at a time, and snapped on again, until half of them are on each side of the pole. A running board is only about eighteen inches long and there is a liability of it turning over and twisting all ten wires together. On this account it is found necessary to fasten an old end of rope to one corner and if the running board turns over, this rope can be pulled and so the tangle unwound before passing the next pole. Six or eight feet of old rope is generally enough. The swivel on the running board is supposed to take care of this and should be given a chance to do so by greasing it.

The draw rope may be pulled by any convenient means; a truck answers very well, or the truck may be provided with a drum and itself remain stationary. The drum may wind the rope on itself as a winch, or have only two turns as a capstan, and be coiled by hand. The latter gives the finest control. Using the truck to travel along the road as a tractor usually requires more room than is available. Teams must of course be used this way.

Pulling with two ropes is faster as no stops are required, it requires two drums however, and the men still have to pass the running boards over the arms.

Another method is to use a shorter draw rope, about three and a half spans long. This is threaded and drawn three spans, then threaded the next three, and drawn forward three more. A shorter rope still, which has to be threaded at every pole can be used by smaller outfits using a team.

It will often be found best to put a brake on the pay-out reels, so as to avoid the wire hanging down dangerously. The place to do this is at the guide bar using string tied several times around.

Physical transpositions may be thrown in at the wire wagon and "chased" forward as required. The writer has not thrown in phantom transposition from the wire wagon, but has no doubt it may be done.

When the first mile is run out, it is dead-ended at the first pole and stretched from the far end. The wire truck is then moved forward two miles and pays out a mile each way. At the same time the first mile is being tied in.

In stringing over dangerous places where no guards are fitted, it will pay to put up a temporary guard. An old tennis net with a hand line tied to each corner may be quickly spread and removed.

Newport News, Va.—York and Warwick Telephone company has purchased from the Chesapeake and Potomac Telephone company, the part of the plant in York and Warwick counties connecting with the naval mine base.

Our Literary Digest

Review of Recent Publications on Telephony and Allied Subjects

Transmission Line Formulas. By H. B. Dwight. D. VanNostrand Co., New York.

This is a second edition of a work originally published some dozen years ago. It is designed to facilitate the computation of the electrical characteristics of electric transmission lines and for that purpose charts, tables of formulas and tables of line constants are arranged for convenient reference. The book is primarily of interest to power line engineers but the fundamental formulas for the transmission line are identical with those used in the theory of telephonic transmission. So that certain chapters apply to telephone transmission as well.

Telephone Communication. By Charles Allen Wright and Albert Frederick Puchstein. Mc-Graw Hill Book Company, New York.

Extensive and intensive research in the communication laboratories and the development of measuring apparatus of a sensitivity, capable of measuring telephonic currents, have greatly broadened our knowledge of the underlying principles of telephone communication. Much of this material has been available in scattered papers but, until the publication of the present volume, a summary of the accomplishments has not been available. The authors, both of whom are professors in Ohio State University, have drawn from this growing literature and present in this book, in consecutive fashion, the present state of knowledge of the production and transmission of speech currents. In order to place limits upon the treatment, the authors have confined their text principally to that class of electrical phenomena which they designate as "medium frequency currents"; i. e., above the low-frequency or power currents on the one hand, and below the high-frequency or radio currents on the other. Where reference is made to one or the other of the two latter classes, it has been done only to point out the relations of the latter to telephone communication. This limitation automatically excludes the subject of switching and connecting telephone lines, since this subject involves the low frequency rather than the voice frequency range of currents.

The text is divided into four general topics or parts. The first part is a general discussion of the telephone problem and includes chapters on sound telephone service, fundamental telephone and telegraph circuits and telephone transmission and its measurement.

Part II is a rather detailed discussion of telephone apparatus and telephone lines. Chapters on transmitters, receivers, transformation of currents, resistance, inductance and capacity effects, distribution of current and electromotive force over lines and electrical filters and networks make up this part of the book.

Part III deals with recent developments including vacuum tubes, repeaters, public address systems, carrier-current telephony and radio telephony. The final section is devoted to maintenance of the telephone plant with particular stress on the electrical measurements necessary and on inductive interference and cross talk. Two appendices present the electrical fundamentals which apply and a course of laboratory exercises for student use.

The text assumes a knowledge of mathematics up to and including differential equations such as ordinarily are taught in technical schools. Each chapter includes a list of problems on the subject matter of the chapter and a list of references for consultation. The material is well selected and, in general, is well presented, the chapter on electrical filters appealing to the reviewer as being particularly well done. The physical appearance of the book would have been improved by a better selection of photographic material for reproduction, and a number of statements either lacking in clarity or of doubtful accuracy have crept in, either through hasty preparation of the material or from lack of careful editing. However, these minor defects do not detract greatly from the value of the book as a text book or as a reference book on electrical communication for libraries.

Rundfunktechnisches Handbuch, von Heinrich Wigge. Verlag von M. Krayn, Berlin.

This German publication is a handbook for radio amateurs who are interested in building their own receiving sets. It differs from most American publications of similar type in that more complete discussion of theoretical principles is included. Radio amateurs who number among their accomplishments the ability to read German will find a wealth of suggestion in the way of details of construction of various elements of a radio receiving set.

Telephone Companies' Earnings Increase Substantialyl

The aggregate September operating income of seventy telephone companies of the United States came to $16,046,481, compared with $13,532,751 for the corresponding month last year. For the first nine months of the present year the aggregate operating income of these same companies totaled $135,586,795, compared with $107,780,216 for the corresponding period last year.

"Interdependence" Illini Cry

Illinois Association in Solid Front at Meet

Springfield, Ill.—Harmonizing with the presidential address keynote of "interdependence," the Illinois Telephone association's 700 men and women in attendance at the annual convention worked as a unit in tackling the industry's problems—among those deemed most pressing being transmission maintenance, public relations and financing.

F. A. Norris, of Monmouth, who was re-elected with the rest of last year's administration, counseled the association members to take home with them a firm resolution to promptly get their toll lines in proper condition and be prepared to enjoy a fair share of toll business. The matter of interdependence was an important one in rates, Norris stressed, citing cases of protests made against a company getting fair rates when its neighbor was struggling along under an inadequate rate, but making no complaint.

Services of the association traveling chief operator and its new help in plant engineering were detailed in the presidential address.

"Telephone companies," said the Illinois president, "may be divided into two general classes: The ones where the management and owners have carefully scrutinized their business, have gotten their house in order, are giving a first quality brand of service and are getting adequate rates therefor; the other class, those that have been living a hand-to-mouth existence and are giving a correspondingly poor grade of service because they are not getitng enough money to even take care of the necessary maintenance charges, let alone have some for dividends or surplus.

"This fact was brought very forcibly to the minds of some telephone owners during the disastrous sleet storm of last winter when some plants were nearly wiped out and the owners had no money and, what was worse, no credit whereby they could borrow money to rebuild their properties into a serviceable condition. Yet this condition resulted primarily from the fact that over a long period of years these exchanges had been receiving inadequate rates for the service they were rendering, so that when confronted with the conditions brought about by the sleet storm, they were entirely without means of restoring their service."

Secretary-Treasurer J. G. Mitchell's report cited the work of the association in helping member companies to get financing that would put them back on their feet after the disastrous storm that hit Illinois last December. He called attention to the toll revenues that "are the deciding factor in many cases between an annual operating loss and a small return on the actual investment." He emphasized the necessity of a proper adjustment of rates, and told of the work the association is doing to increase toll revenues. A program of district conferences of the most helpful nature is being arranged for Illinois in 1926.

E. D. Glandon, secretary and general manager of the Pike County Telephone Co., in speaking on "Concrete Co-operation with Other Utilities," stated that the inductive interference problem in Illinois was one where the rural lines would have to maintain that grounded service is entirely defensible, since the increased charge incident to metallicizing these lines is out of the reach of many. He outlined the work of his company with the Central Illinois Public Service Co. and with the commission in handling phases of interference problems, telling of one case where his company sided with the Central Illinois Co. against a possible invader of the power and light company's territory, because the telephone company knew it always was sure of a square and considerate deal from the Central Illinois interests with whom he had been in a number of conferences. He counseled his hearers never to lose sight of the general public welfare when putting forth the case for the telephone company's protection against interference.

Following Mr. Glandon's remarks came two interesting addresses from well known engineers: Ray H. Manson, chief engineer for Stromberg-Carlson, who spoke on radio as it concerns the telephone business, and J. D. Burnes, chemist and preservation engineer of the Page and Hill staff, who addressed the meeting on wood preservation.

"From the standpoint of telephone companies, radio is entertainment," said Mr. Manson. He detailed the close relations between the radio and telephone fields in both operating and manufacturing departments, and related how telephone companies are supplying subscribers with radio programs, relayed by the company wires to loud speakers in the subscribers' homes. He warned telephone companies that, unless they awakened, power companies would capture this business. He cited an $11,000,000 program of one power company to push wired-wireless. His talk was illustrated by slides and had an impressive effect in focusing attention on the development of profitable possibilities in radio.

Mr. Burnes paid particular attention to the poisoning of the food supply of pole-destroying factors as the one practical method of preserving an unbroken area of wood at the ground line.

Harry Eldridge staged a "Public Relations Hour," in which an all-star cast composed of Misses Helen Bidinger, Sarah Brownlee and Virginia McCullough was presented. This performance went over so well that a number of managers put in bids for its presentation before their employees and local commercial organizations.

Harmonious and close contact between the Illinois association and the state government was apparent in the following two addresses: C. G. Bennett, chief engineer of the Illinois Commerce commission, spoke briefly on some problems of the engineering section of the commission. He made a strong point of the protection of exchange areas. F. W. Potter, formerly state superintendent of insurance, talked on coverage against special hazards, with particular reference to sleet insurance.

An intensely practical feature of the program was the session on telephone transmission maintenance. Fred F. Snyder, the association's transmission engineer, spoke of the importance of tests, the differences between local plant and toll testing, and the character of tests for different types of equipment. He presented briefly some of the major points in test work. W. C. Hall, of the Illinois Bell's engineering staff, gave an illustrated talk on preventative maintenance. His demonstrations emphasized the value of the association's work in transmission engineering.

President MacKinnon, of the National association, told of efforts of the national organization in facilitating telephone financing. Bondholders of telephone securities are getting 5.5% return and stockholders 4.5%, he said, calling attention to the necessity of this return being increased.

The biggest traffic conference ever held by the association was conducted during the meeting, with a number of valuable and interesting papers presented on specific details of operating work.

New York Hikes 1925 Outlay to $60,981,935

New York City—New York Telephone company has authorized the additional expenditure of $4,180,365 for new construction in various parts of the territory served by the company. This brings the total of appropriations made since the first of the year to $60,981,935, of which $53,953,090 was set aside for the enlargement of plant facilities in the Metropolitan area.

"Tightest man in the world," according to the Relay, "is the fellow who tried to send a night telegram during an eclipse of the sun."

Unit Line in Underground

The Subscriber Line Is Followed Through Underground Plant—Brief Review of Position of Unit Line in Each Portion of the Plant—Fifth Article of the Series

By JOHN M. HEATH,
First Lieut., Signal Corps, U. S. Army

20. *Underground Conduit.* Just as a pole line is necessary before there can be aerial cable, likewise underground conduit is necessary before there can be underground cable. Conduit plays no part in the electrical operation of a telephone system, but is a very important and reliable part of the outside plant.

Before cables can be drawn into ducts of the underground conduit (Fig. 16) manholes and conduit must have been completed, the construction of which requires plans by the Plant Engineer and a permit from the city, then a construction party to build it.

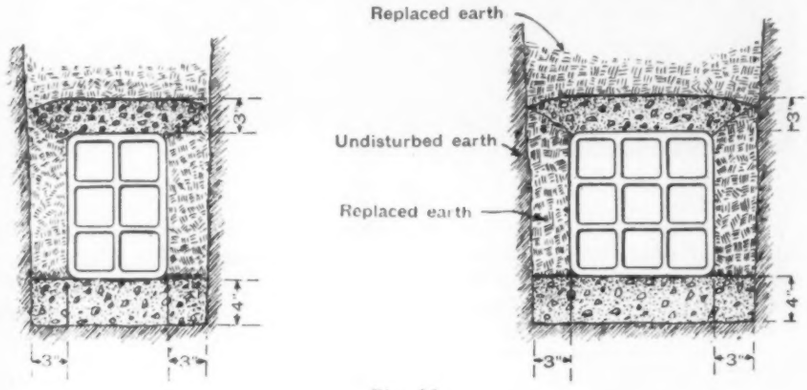


Fig. 16.

Conduit runs are usually made in the region surrounding the central office due to the congestion of cable on poles and their general unsightliness when there is more than one cable run on the same pole line.

Suppose for instance, that a central office is located at the approximate wire center of a certain exchange area, and there are cables coming into the central office from all parts of the office area, the cables will get more numerous the nearer the central office. Say one comes from the northwest, one from the west, and one from the southwest, and all three run to the central office on the same street. Obviously the place to begin the conduit run is at the junction pole of the three cables, and likewise the junction box would be located there.

Conduit runs are made in 2, 3, 4, 6, 8, 9, 12, 13, 15, 16, 18, 20, 21, 24 duct sizes, depending upon the cable requirements of the particular central office.

21. *Manholes.* Manholes are an integral part of the conduit system. They are usually spaced about 500 ft. apart; depressions at points along the run are taken advantage of for location of manholes for drainage purposes, provided these meet all engineering requirements of the run.

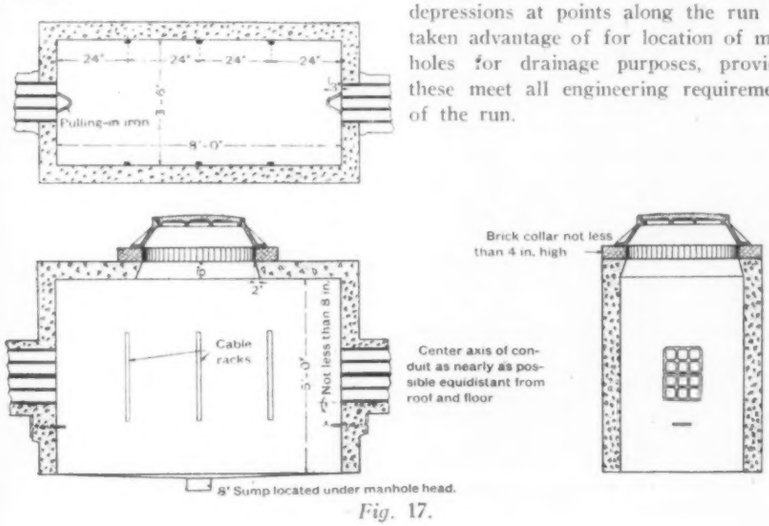


Fig. 17.

Manholes are made of brick, or concrete, and provided with a cover set flush with the level of the street (See Fig. 17). They are also provided with a drain to the sewer wherever possible; where no connection with a sewer is possible they are provided with a sump. A sump is a hole dug into the ground underneath the manhole, and provides drainage by means of seepage into the ground.

Manholes are provided with cable racks upon which to lay the spliced cables (See Fig. 18).

22. *Laterals.* Underground cable is brought from the manhole to the junction box through a lateral. (See Fig. 19). The lateral is made up of sewer tile and iron pipe. The sewer tile extends from the manhole to the bottom of the pole on which is located the junction box, and terminates into a "bend." The "bend" extends about two feet above the ground and alongside the pole, on top of the "bend" is set a piece of wrought iron pipe. This extends up the pole to a point 8 ft. above the ground.

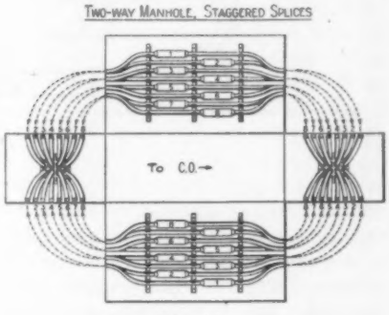


Fig. 18.

23. *Underground Cable.* From an engineering and maintenance standpoint, underground cable has everything in its favor. Once in place maintenance is practically nil, while cables coming into the central office via underground lend themselves generally to a much better distribution than do cables coming in overhead. In the first place the distributing frame, and therefore the terminal room, can be located on the first floor where it normally belongs, and in the second place the terminal room being on the first floor automatically places the switchboard on the second floor where it normally belongs.

Underground cables are usually not less

than 400 pair and are as large as 1200 pair. The general type of manufacture, insulation, sheath, etc., is the same as described for aerial cable.

Underground cables are drawn into ducts from manhole to manhole (approximately 500 ft.) and then spliced in the manhole (See Fig. 18). As mentioned in connection with the junction boxes, an underground cable may terminate in more than one junction box through laterals working from different manholes. For instance a 400 pair cable may leave the central office, 200 of these pairs may terminate at Adams street, and a 200 pair cable extend on 500 feet farther to Jefferson street, and terminate in a junction box there. The manner of terminating underground cable in the junction box has been described.

At the central office end, the underground cables enter the central office via a large cable subway. Into this subway is spliced onto each cable a piece of office distributing cable, its external appearance the same as other cable, but the conductors are cloth insulated. This is for terminating the cable on the arrester frame in the terminal room. Each cable pair is terminated in the central office on one arrester.

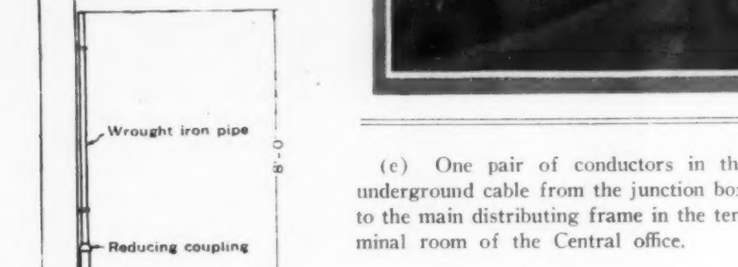

Wrought iron pipe
8'-0"
Reducing coupling
St'd cast iron bend
Sewer tile
Bottom of joint left open if impossible to drain toward manhole, and broken stone placed under joint.

Fig. 19.

The unit line, Fig. 19, occupies one pair of conductors in the underground cable from the junction box to the arrester frame.

24. *The Unit Line.* Now for a brief recapitulation of the route of the Unit Line in the outside plant.

(a) From the protector to the cable terminal, the drop.

(b) One pair of binding posts in the cable terminal.

(c) One pair of conductors in the aerial cable, from the cable terminal to the junction box.

(d) One pair of fuses in the junction box, connecting the aerial and underground cables.

(e) One pair of conductors in the underground cable from the junction box to the main distributing frame in the terminal room of the Central office.

Finds Use for Doughnut Hole

"Get the owner's point of view and no one's is too hard to handle on a tree trimming job." That's the policy of W. T. Edwards, sub. district plant chief of the Cumberland at Nashville, Tenn., who is responsible for the unique tree trimming job shown above. The doughnut trim is the result of five years' work and attracts the attention of hundreds of tourists on the Lebanon pike. The unusual aerial tunnel now is the source of considerable pride to the owner of the land upon which the tree stands.

A Substitute for Wiped Cable Joint

Geo. A. Bishton, of Cedar Rapids, Ia., has worked out an idea which he says will prove of great value in any telephone exchange in which a regular cable-man is not employed.

This is a substitute for a wiped joint in cable splicing, it is not a special sleeve or a molded joint; no melted metal or wiping cloth is necessary, and yet the joint is as well soldered, without overheating, as though wiped by an expert.

Straight or branch splices, horizontal or vertical, can be made with equal ease and success. A tight joint is certain. Well adapted for split sleeves. Any good trouble-man can learn the trick in a few minutes.

Copyrighted drawings and instructions will be sent to any telephone company on certain conditions.

Books on Vacuum Tubes in Telephone Practice

A subscriber in a Southwestern State writes as follows:

"We have received your catalogue of good telephone books, for which we thank you. It does not, however, list just what we want, so will ask if you can supply us with a description of the use of vacuum tubes in long distance telephony. The college here wants something on that subject for their library."

We are not familiar with any book that is devoted exclusively to the subject of the use of vacuum tubes in long distance telephony. A number of scattered articles have appeared in various telephone journals, in the Bell System Technical Journal and in the Journal of the American Institute of Electrical Engineers. One of the most complete treatments of the vacuum tube in book form is "The Thermionic Vacuum Tube" by W. J. Van der Bijl (McGraw Hill Book Co.). Applications to long distance telephone lines are described. Other recent books contain one or more chapters on this topic. Among them are "Telephone Communication," by Wright and Puchstein (McGraw-Hill Book Co.); "Transmission Circuits for Telephonic Communication, by K. S. Johnson (Van Nostrand), and "Principles of Transmission in Telephony," by M. P. Weinbach (McMillan). In all of these books the treatment is from the mathematical as well as the physical viewpoint. Any of the books named may be secured through the book department of TELEPHONE ENGINEER.

Power Driven Automatics

Power Driven Machine Switching Systems Differ Radically from the Familiar Step-by-Step Automatic — A Brief But Clear-Cut Description of the Fundamentals

By F. J. DOMMERQUE,
Fellow, A. I. E. E.

Since the introduction of the Paneltype Machine Switching System by the Bell telephone companies in the large cities has expanded to a considerable extent, every telephone man should be imbued with a desire to familiarize himself with the principles of this system, regardless of whether he is in the Bell service or not.

There seems to be some variance as to what machine switching really means. Some consider the term equivalent with "Automatic," others again restrict it solely to power-driven installations. An acceptable classification may be suggested as follows: Any telephone system which is not manual may be termed "automatic." There are also semi-automatic systems, but as such systems are as a rule only stepping stones to full automatic systems, or serve particular purposes, they will be left out of consideration. Automatic systems are then divided into three classes, according to the motive power of the switches, namely: Step-by-step motion systems, power-drive systems and relay automatic systems. The latter type will also be omitted in the following discussion, as not having progressed far enough in its application to be considered standard.

The step-by-step motion, as exemplified in the original Strowger System, is two-directional; that is, the contact devices of the switches move in two directions, vertical and horizontal; it permits of direct selection of numbers, that is, the number of impulses sent into the motor magnets for their stepping action is the number indicated by the called-for number.

The power-drive motion is one-directional and may permit of direct impulse sending, but in most cases, as, for instance, in all Western Electric systems, requires a "translation," the selection of group and line switches or rather of the terminals in them, being effected by reverse impulse sending, as will be described at some future occasion.

By this time every telephone man has learned the fundamental conception of the step-by-step motion systems. He has acquired some knowledge of the working of the Strowger System from current literature and from books. Therefore, no detailed description seems to be necessary and it is assumed that the references made to the step-by-step system hereafter are easily understood.

Editor's Note—Readers of TELEPHONE ENGINEER who have followed previous articles by Mr. Dommerque will be pleased to know that he has prepared other articles on Power-Driven Machine-Switching Systems which will appear from time to time in the pages of this journal. Mr. Dommerque is exceptionally well qualified to write on this subject as he has had extensive experience both in this country and in Europe where he spent several years as special representative of the Western Electric Co. in the introduction of its automatic systems into various countries.

Some telephone men will remember that, around the year 1900, Mr. Faller designed a machine for automatic telephone operation and made a model which represented a mechanical operator. He gave life to his mechanical operator by having it driven from a continuous source of power by means of shafting. Faller's mechanical operator did not survive the experimental stage; but the idea of a continuous power-drive was taken up by Lorimer and by the Western Electric Co. With step-by-step motion, the stepping is performed by electro-magnets operating some kind of lever or pawl arrangement to step up and around, the magnets being controlled in their steps by battery circuits, opened and closed in quick succession. The circuit controlling device is an impulse wheel in most installations, which is operated by the subscriber to make the number of breaks in the circuit through the magnet, the same impulse wheel being rotated for each digit until all the digits in the called number have been "dialed," consequently the setting of one digit wipes out the setting of the preceding one. Lorimer had designed a type of impulse-making device whereby the subscriber first sets all the digits in the called number so that no digits are wiped out, and then sets the wheels going, which select in the proper order.

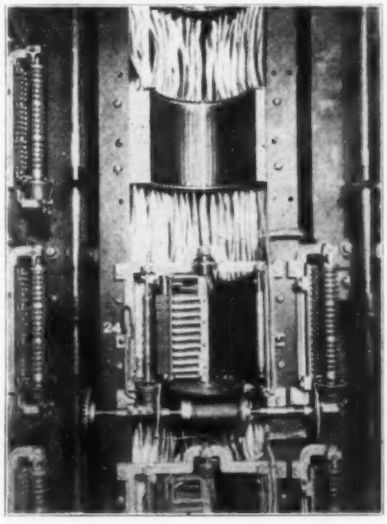


Fig. 1—Power Driven Switch with Trip-spindle. Rotary (European) W. E. Type.

The Lorimer system had been developed far enough to permit of practical exchange work; but its maintenance was rather difficult, on account of the design of its switches. The system certainly contained valuable points which have contributed greatly to the successful development of the later power-drive systems of the Western Electric Co., which practically have superseded the Lorimer system.

The method of power-driving depends on the kind of switches to be driven. The Western Electric Co. has in operation two kinds, a rotary switch and a panel-type switch. The rotary switch is used in Europe and the panel-type in America. Although the rotary type switch may not interest the American telephone man, it may serve to illustrate one magnetic-clutch type.

It was developed prior to the panel-type switch and, therefore, contains many fundamental ideas. The switch has 200 contacts arranged in ten levels of twenty contacts each. Ten sets of brushes or wipers wipe over the contacts (it is not a wiping as in the Strowger type switches, but a somewhat more complicated affair; however, the results are the same). The brushes are carried by a shaft which stands vertical and is mounted upon an horizontal disc. The combination of this disc with its switchshaft and a frame attached to it which holds the brushes, forms the brush carriage, which is set in motion by the magnetic clutch located below it.

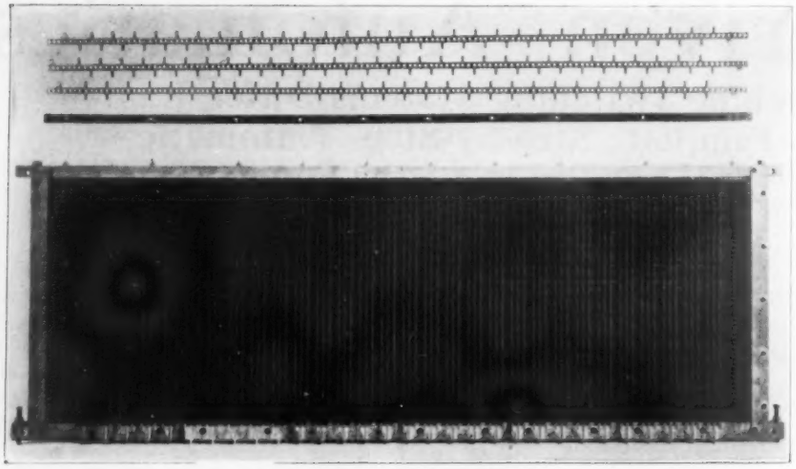


Fig. 2—Panel Type Bank of 100 Lines.

On top, in Fig. 1, is illustrated a semi-circular contact bank with the brush carriage removed, and below it another bank with its brush carriage. Underneath the horizontal disc which has flexibly attached at its outer rim an iron ring, is located a magnet spool, through which passes loosely a horizontal shaft carrying three vertical iron discs; the one at the extreme right and end moves a sequence switch (a device to be discussed some other time); the disc to the right of, and close to the magnet spool attracts the iron rim of the horizontal disc above it, when current flows in the magnet spool, and thereby transfers the motion to the brush carriage; the disc to the left of the magnets pool engages the so-called trip spindle, a device which controls the brush action.

The American type, Western Electric switch is a 500-line switch; its bank consists of five groups of contacts of one hundred lines each and is built up of horizontal brass strips, insulated from each other as shown in Fig. 2. The strips in this bank are straight, thus the surfaces of the bank (both sides of the bank being used) are flat, representing a panel, whence the name "Panel type." Fig. 3 illustrates a 500-line switch of this type, termed a "Frame." The terminals consist of lugs on each side of the strips (three terminals for each line); they are multipled horizontally across the panel.

The brushes, one of which is shown in Fig. 4 in two positions, open and closed (plan and side views), are attached to a brush shaft or lift rod, which can move up and down in front of the panel. Fig. 5, which is a diagram of the essential parts of the contact making and lifting mechanism, shows the lift rod 8. The parts as they are designed for actual service appear in the other illustrations. There are five sets of brushes on a lift rod, but four only are shown in Fig. 5. Each set of brushes is carried by a separate brush carrier mounted on the lift rod; there are four contact springs to each brush, two inner springs and two outer springs; the outer pair engages with the outer two contacts of a line or trunk and the inner pair clamps the middle contact. Normally, however, the springs are held apart by a roller of insulating material at one end of a bellcrank lever, so that the brushes may pass by the terminals without touching them. At the other end of the lever is a trip lug acted upon by a brush tripping device carried on a separate rod, No. 7—in Fig. 5, parallel to, and near the lift rod. The lift rod is the thicker one. Its lower part forms a flat ribbon, as can be seen better from Fig. 6. This ribbon has a series of perforations corresponding to the vertical spacing of the terminals. Into the perforations falls a projection on the armature of the release magnet to hold the rod in position when the brushes are in contact with the proper terminals. The trip rod, No. 7, is stationary but it can turn. To each brush set corresponds a tripping device or finger; the five fingers are spirally offset and are arranged at progressively increasing distances above the normal positions of their respective trip lugs on the brushes. If the brush shaft is moved upwardly until the trip lug of the controlling lever of any desired brush set occupies a position opposite its respective trip finger and the trip rod is then rotated, the trip finger individual to the selected set will engage its respective trip lug; the other trip fingers will not engage their respective lug at this time, being positioned either above or below the same, respectively, but will pass through the line of travel of the lugs to the other side thereof. Upon the continued upward movement of the brush shaft, the brush controlling lever will be rotated and the brushes will be forced to their operative position, and the trip lug passing from contact with the trip finger will allow the trip finger to be rotated to a position in alignment with the other trip fingers by its spring. When the lift rod has passed beyond its brush selecting stage, the trip magnet will be de-energized and the trip rod will return to its normal position.

In Fig. 5 also is shown, diagrammatically, how the brush shaft or lift rod is moved up and down. At the bottom of the figure, a pulley mounted upon a constantly rotating shaft is shown at the right of the brush shaft; on the opposite side of the shaft is seen an idler carried by a lever frame at the end of the armature of an up-drive magnet. Upon energization of the magnet, power will be transmitted through the lever to the idler so as to clamp the brush shaft between the idler and the power pulley and thus cause the shaft to be lifted. A duplicate of this electro-magnetic clutch is shown above the first mentioned one; it also lifts the brush shaft, but does it at a greatly reduced speed. The high speed clutch mechanism carries the brushes over

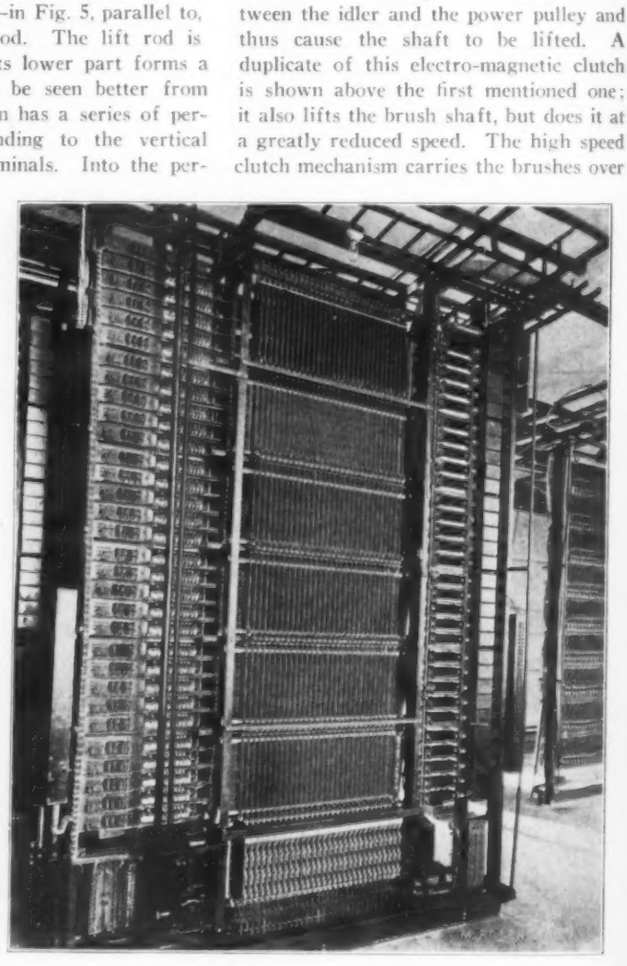


Fig. 3—Panel Type Frame.

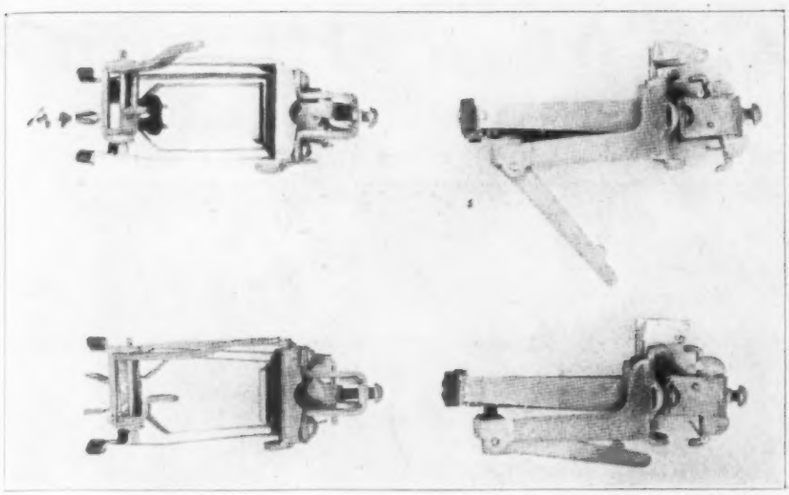


Fig. 4—Selector Multiple Brush Shown in Operated and Non-Operated Positions

the terminals by groups of ten; the low speed is used for unit selection.

Between the two up-drive mechanisms, a third power pulley and magnet with idler are inserted but mounted so as to cause a reversed motion of the brush shaft for release. The shaft is not returned to normal by gravity to avoid jar and undue wear.

In the lower part of Fig. 6, a motor is mounted at the left upon the base-plate. To the right of the motor is the line of magnetic clutches associated with the lift rods which move up and down in front of the banks above the clutches.

With step-by-step motion of switches, no current is used during normal condition of switches, while with power-drive a certain amount of current is wasted in running the shafts when the switches are idle. Although this waste is very small (two horse power for a 10,000 line exchange is sufficient to run the switches in the busiest hours), the amount of current consumed may be reduced to a minimum by arranging the motor system so as to operate only such parts of the system as are in action; in other words, during the peak of the load, all shafts may be going and with decreasing load shafts may be cut out; during night time no shafts may be turning normally, but when a call comes in, a motor may be started automatically by the incoming call.

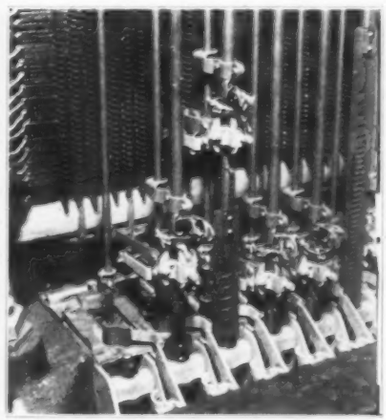


Fig. 6—Brushes and Control Mechanism.

The characteristic difference between power-drive and step-by-step motion can be stated as follows:

1. Any switch operating on the step-by-step principle is guided in its motion by three magnets (vertical, rotary and release magnet). The power-driven switch is controlled in its motion by an electro-magnetic clutch or equivalent device.

2. The magnets in the step-by-step switches require powerful currents which can not be sent over the line; hence, local circuits for same must be provided, which are opened and closed by relays at certain fixed periods, the set of relays associated with such a switch comprising a greater or lesser number, according to the system and according to the functions to be performed. As a rule, it will be found that with fewer relays each relay has to perform more complicated operations and consequently is harder to keep in adjustment and more likely to cause trouble. With power-drive, these complicated relays can be omitted and are omitted in the W. E. systems; instead, the springs which open and close circuits are operated by discs or cams, mounted upon a spindle, which is rotated by means of an electromagnetic clutch taking hold of the continuously moving shaft, as mentioned before. This mechanical relay is the "Sequence Switch." It obviates any such movements as make-before-break contacts, side switch or gang switch performances or escapement movements; it simply makes and breaks. Where only closing of battery circuits for purely electrical purposes, like lighting signal lamps, is to be effected, ordinary type relays also are employed in power-drive.

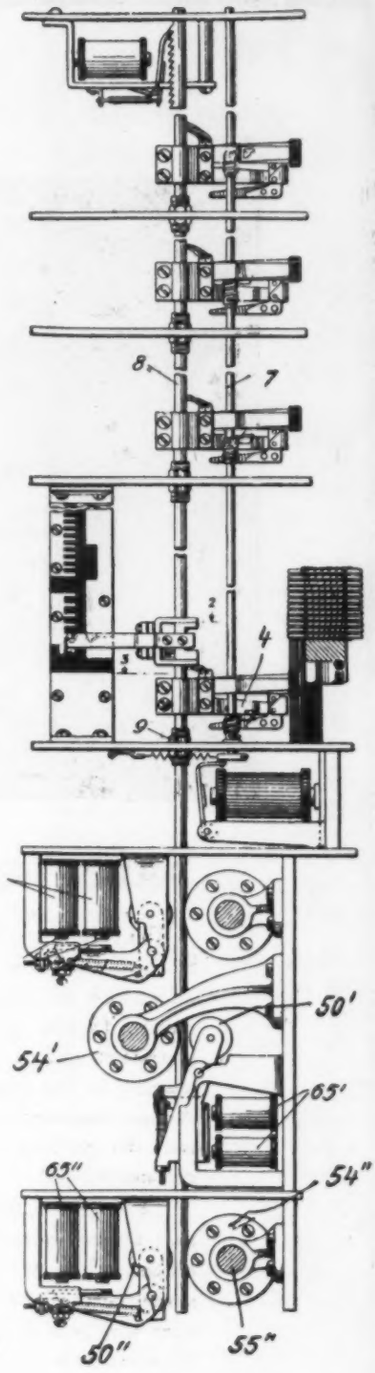


Fig. 5—Contacting and Lifting Mechanism.

3. On account of the practically unlimited power, the power-drive switch need not be restricted in its dimensions. In a step-by-step switch, it is customary to limit a bank to one hundred terminals which allows of shaft dimensions inside easy lifting limits; in a power-driven switch, the bank may be made whatever one pleases; thus the W. E. panel type bank contains terminals for as many as 500 lines. This freedom is of importance in the arrangement of trunk groups.

Safeguarding the lanes of speech

The New York-Chicago telephone cable has been completed and is now in service. A triumph of American telephone engineering, the new cable is the result of years of research and cost $25,000,000 to construct. Its first reach extended along the Atlantic seaboard, then steadily westward until this last long section to Chicago was put into service.

To the public, this cable means dependable service irrespective of weather conditions. It is now not likely that sleet storms, which at times interfere with the open wire type of construction with 40 to 50 wires on a pole, will again cut off the rest of the nation from New York or from the nation's capital as did the heavy sleet storm on the day of President Taft's inauguration.

The new cable means speedier service, as it provides numerous additional telephone circuits and will carry a multitude of telephone and telegraph messages. It would take ten lines of poles, each heavily loaded with wires, to carry the circuits contained in this most modern artery of speech.

This cable, important as it is, is only one of the Bell System projects that make up its national program for better telephone service to the subscriber. It is another illustration of the System's intention to provide the public with speedier and even more dependable service.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM
One Policy, One System, Universal Service

Know How to Make Tests?

This Tells How to Handle Them—Aerial and Underground Cable—Location of Opens—Water Soaked Cable—High Resistance Crosses—Toll Line Faults and Other Troubles

By P. KERR HIGGINS

The loop tests or loop methods used in telephone testing are very practical and extremely reliable. In the preceding article we considered the two principal loop tests: namely, the Varley and Murray, both of which are in daily use at the present time with those responsible for making fault locations. On page 38 of the November issue of TELEPHONE ENGINEER, we touched upon the location of a fault on a multiple tap of a telephone cable. Fig. 1 illustrates the lay-out. The first test is made at the point C and, if the test has been carefully made and conditions are favorable, the fault will seem to be at N. The second test then is made at B, when the true location of the fault will be obtained; namely, at X. A more complete sketch of the arrangement for the test is shown in Fig. 2.

In order not to be misled by any variation in resistance, due to changes in temperature, it has been found convenient to measure some known length of circuit once each week or two and divide distances by resistance to obtain the proper constant. This is necessary due to the fact that the constants in underground cable will vary approximately 10 per cent between summer and winter temperatures.

Where cables of two different gauges are spliced together, it is easy to figure out the location without making any special gauge correction. For example, take a case where a pair of wires of one gauge is attached to another pair of equal length but different gauge and assume the loop resistance to be 40 ohms and the Varley loop balance obtained was ten ohms with equal bridge arms. This would indicate that the fault was 5 ohms from the distant end. Since we know the two gauges, we can mentally estimate if this amount of resistance will show the location of the fault to be beyond the junction point of the two sizes. If not, then multiply by the constant for the gauge wire on the distant end. This will give directly the resistance from that end of the fault. In any case where the balancing resistance shows the location to be in the section nearest the locater, instead of multiplying the constant by the rheostat reading, subtract this reading from the total loop resistance and multiply the difference by one-half the constant for the gauge wire nearest to the tester. This applies to all cables except very short ones where locations are not accurate for the reason that the average bridge is not subdivided below one ohm in the rheostat. When it comes to a question of inches on a short length of conductor, either the Murray or Varley test with unequal bridge arms should be used.

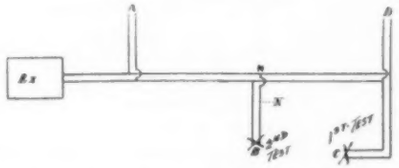


Fig. 1—A, B, C, D, Multiple Taps; N, Apparent Fault; X, Actual Fault Located by Second Test at B.

Since the universal Varley formula for equal bridge arms is $R = r - 2a$, it is possible to obtain the location by solving for a if the gauge of the bad wire is known. When a good wire of large diameter is used and the trouble is near the distant end of the smaller wire, it frequently happens that a balance cannot be secured when the bad wire is in series with the rheostat. In such cases the wires on the respective binding posts should be reversed. Then balance in the usual manner, using the formula with R negative

$$\text{or minus } R = r - 2a. \quad a = R + \frac{r}{2}.$$

Back Varley Test

In this test, R the variable resistance is adjusted until the least possible deflection is obtained on the galvanometer. Then as the ratio arms A and B are equal, $R + a = C + Y$, but $X = C - Y$ when C = the resistance of the good wire and Y the resistance between the fault and the distant end. Therefore $R = 2Y$. Or the resistance of the fault from the distant end Y equals ½R ohms. This test is not very accurate for cable work, but very serviceable in making tests on open wire work.

Abnormal Conditions in Testing

In making loop and other tests with the Wheatstone bridge, one frequently encounters abnormal conditions to which the regular testing procedure does not apply. Among these might be cited the following:

1. Faulty wire of known length and one good wire only of unknown length and size.
2. Good and faulty wires of different known sizes and lengths.
3. Faulty wire of two different sizes.
4. Loop of different sized conductors.
5. One good wire of unknown length and two faulty wires equal in length and size.

In order to correct some of these abnormal conditions quite complicated calculations must be made and it is suggested that those interested should secure from the manufacturer of the particular bridge used data pertaining to such. However the following brief hints may be helpful.

1. When there is only one good wire the size of which is unknown, it is necessary to make tests from each end of the faulty wire. To do this first connect enough wire to each end of the good wire to reach the testing set. Throughout both tests this exact amount of wire must be used. The same procedure must be followed with reference to the faulty wire and if any additional wire is necessary corrections must be made.

2. When the good and bad wires are of different sizes and lengths make connections and balance in the usual manner for the Murray loop test. Multiply the

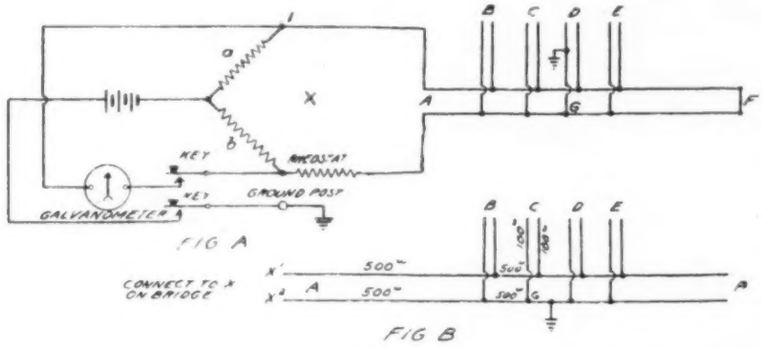


Fig. 2.

length of the good wire by its rated resistance per thousand feet and divide the product by the rated resistance per thousand feet of the bad wire. Add this result to the length of the faulty wire and use the sum for L (length of loop) in the regular formula for calculating the distance to the fault.

3. When the bad wire consists of two different known sizes and lengths, and wires are available to determine the distance to the fault by Fisher's method (which will be described later), make the particular test required. Let l and r equal respectively the length and rated resistance per thousand feet of the first size of wire and letting l′ and r′ equal respectively the length and rated resistance per thousand feet of the second size wire. Then substitute for L the length of the

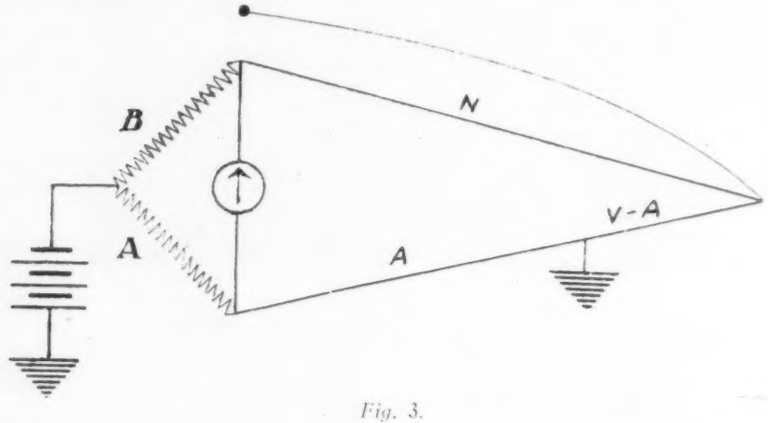


Fig. 3.

faulty wire $(1+\frac{r'}{r}\times l')$ and let d equal the calculated distance to the fault. If d equals or is less than l the former is the true resistance to the fault. If l is greater than d the distance to the fault is $l+(d-l)\times\frac{r}{r'}$.

or both to be used for the good wire, it being only necessary that they terminate at the same point as the bad wire. The procedure is to make connections as for the Murray loop test as shown in Fig. 3. Have the two parts, A and B, of the bridge so arranged that they can be varied until a balance is obtained. The variable rheostat should be used for one of the arms. Now call the resistance to the trouble a, the resistance of the faulty wire r, and the resistance of the other wire which is connected to it and forming the loop n; then $\frac{A}{B}=\frac{a}{r-a+n}$ and $n=\frac{Ba+Aa-Ar}{A}$

Now connect as in Fig. 4 and adjust for a new balance, calling the new reading A′ and B′. Then $\frac{A'}{B'}=\frac{r}{n}$ and $n=\frac{B'r}{A'}$. Equating the two values of n we get $\frac{B'r}{A'}=\frac{Ba+Aa-Ar}{A}$ from which $a=\frac{A(A'+B')r}{A'(A+B)}$

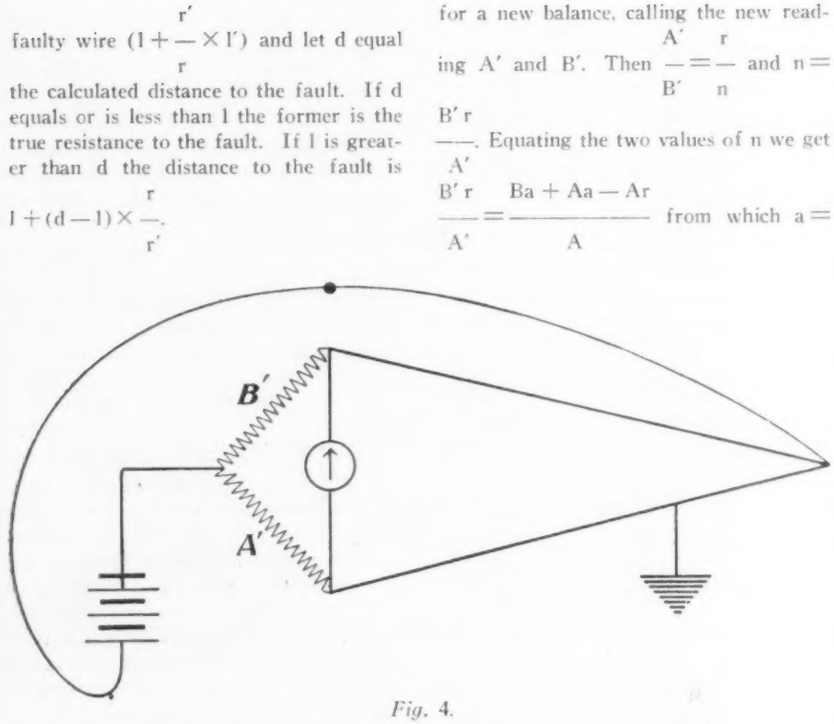


Fig. 4.

Fisher's Method

This method is very convenient and has a wide application in telephone testing as it permits good aerial or cable wires

If the length L of the faulty wire is known and d is the distance to the fault, the above formula may be written $d=\frac{A(A'+B')L}{A'(A+B)}$

4. If the loop is made up of several lengths of conductors of different sectional areas as often occurs when cable circuits are joined to toll circuits, the distance to the trouble is easily calculated by expressing the different cross sections in terms of equivalent length of one of the conductors in the loop. In order to do this the cross sections and the lengths of the different sections must be known. The reduction is made by multiplying the length of each conductor by its resistance per thousand feet and dividing the product by the rated resistance per thousand feet of the size of the conductor to which it is being reduced. An example of this is shown in Fig. 5. In this circuit the cable section E contains 2200 ft. of No. 19 B & S gauge wire. The cable section F, 1,400 feet of No. 22 gauge, and the cable section G, a toll circuit consisting of No. 12 B & S gauge wire, 2,160 feet long. Now to reduce the No. 19 and No. 12 to the equivalent length of No. 22, we have $\frac{2200\times 8.038}{16.12}=1{,}097$ feet of No. 22 is equal in resistance to 2,200 feet of No. 19. $\frac{2100\times 1.586}{16.12}=212.5$ feet of No. 22 is equal in resistance to 2,160 feet of No. 12. This makes the total length of the loop equal to 2,709.5 feet of No. 22 B & S conductor. If the result showed the fault f at a distance of 1,346 equivalent feet from A, of this 1,097 feet are in the section E. Consequently the fault is 1,346 — 1,097 or 249 feet from the point C. In this way the location is given from both points.

5. It sometimes happens that all the wires in the cable become defective and it may be difficult to secure two good wires and apply the test shown in Figs. 3 and 4. If one good wire can be obtained for a loop test, the separate resistances of the good and bad wires can be determined by the following method devised by Fisher and this may be used when all the conductors are bad in a cable and only one aerial wire is available for the test, as follows:

Let b and b′ represent the bad wires and c the good wire.

Measure the combined resistance of c and b and call it r.

Measure the combined resistance of c and b′ and call it m.

Measure the combined resistance of c in series with b and b′ in multiple and call it n.

The arrangement is shown in Fig. 6 and underneath each is the letter indicating the resistance. The formula used is as follows:

The resistance of $b = r - n + \sqrt{n(n-r-m) + rm}$.

The resistance of $b' = m - n + \sqrt{n(n-r-m) + rm}$.

Where the resistance r and m do not differ by more than 2 per cent or 3 per cent, the following approximate and much simpler equations may be employed,

$$b = \frac{3r + m}{2} - 2n$$

$$b' = \frac{3m + r}{2} - 2n$$

This test is only applicable when the bad wires b and b′ are faulty at the same point. The total measured resistances of each loop are represented by the letters r, m, and n. These resistances having been determined, the loop test is then applied and the fault located.

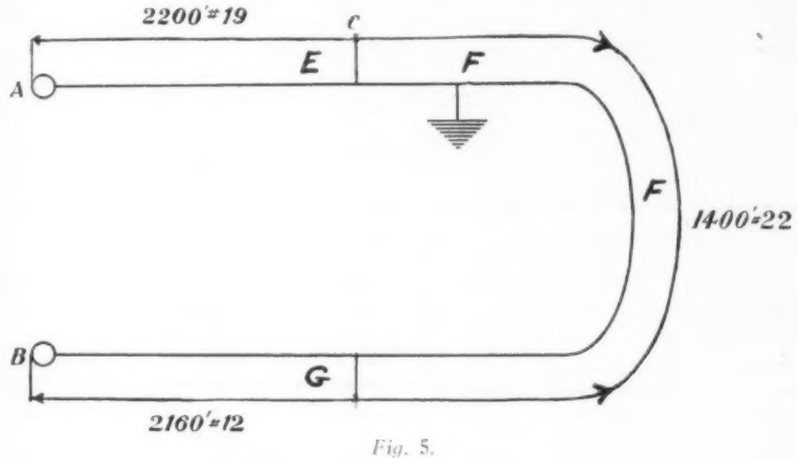


Fig. 5.

Lead Wires

Where lead wires are necessary to connect the lines under test with a testing instrument, the length of these leads must be added to the loop resistance, and from the calculated distance to the fault this must be subtracted. If the lead wires are of different size than the wires under test, multiply the length of each dead wire by its rated resistance per thousand feet and divide the product by the rated resistance per thousand feet by the size of wire in the cable under test. If the resistance of each lead wire is known the equivalent length of the faulty wire having a resistance equal to each lead wire is found by dividing their respective resistances by the rated resistance per thousand feet of the bad wire and multiplying the quotient by 1000. Sometimes it is necessary to employ fixed lead wires whose resistances are unknown. This resistance may be obtained by connecting them at the distant end and measuring the loop resistance. Then ground the connection and apply either the Murray or the Varley loop test. This will give the proportion of the total loop resistance in each wire. This test is also very useful when necessary to balance up circuits used in phantom work where both sides of the physical circuit should be as nearly equal as practical.

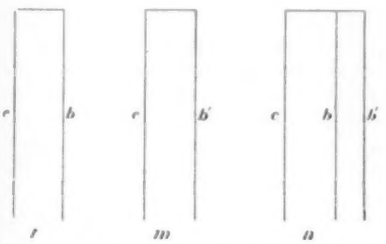


Fig. 6, Varley Loop Test. Ground on Branch and Multipled Cable.

Location of Opens

The location of opens on telephone lines presents difficulty not met with when making measurements for grounds, crosses or shorts.

In many places it is, therefore, the general practice when a complete break occurs to merely locate as between the two stations involved, then to have the line examined in that particular section. This method of course is frequently not only expensive, but the delays cause serious inconvenience. In locating such a break in cable, we depend upon the fact that every insulated conductor whether it is in a cable under ground, under water or in the air possesses capacity and is in reality a condenser. The conductor forms one side of the condenser, the insulation forms the dielectric and the ground the other side of the condenser. This capacity is generally proportional to the length of the conductor. Hence, if we know its capacity per unit length, and can measure the capacity up to the open, we are able to calculate the length of the conductor to the break. The real difficulty to this test is that the capacity is not always uniform throughout the length of the circuit under test. In measuring the capacity by this test the deflection method is generally used. This is done by charging the cable up to a certain potential and then discharging the charge through a reflecting galvanometer. The deflection, however, is liable to be affected through the action of what is called "electrical absorption" which means that the condenser will not immediately return all of the energy stored in it.

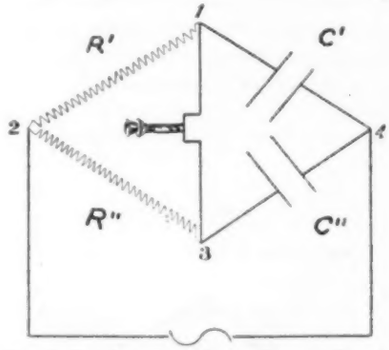


Fig. 7, Testing Capacity to Locate Break.

A method which largely removes this objection is in the use of a simple bridge arrangement, replacing the galvanometer with a receiver and replacing the direct current with an alternating or pulsating current, and compare the capacity of the open wire with the capacity of the good mate of known length. The schematic circuit for this arrangement is shown in Fig. 7. The capacities C′ and C″ are the capacities of an open wire and its good mate respectively. We can balance these two capacities against R′ and R″ the other two arms of a Wheatstone bridge. When the resistances in the bridge are adjusted so that no sound is heard in the receiver, then the points 1 and 3 are equal in potential. The cable capacities represented by C′ and C″ are then charged to the same difference of potential and contain quantities of electricity proportional to their capacities. However, the quantities flowing into the condensers in the same time are inversely proportional to the resistances R′ and R″. Therefore $\frac{R''}{R'} = \frac{C'}{C''}$. It is sometimes difficult to get absolute silence in the receiver and when this is the case then the point of minimum sound in the receiver should be obtained. Since the good and bad wires are under similar condition, their lengths are taken as proportional to their capacity; hence, if L′ and L″ represent the lengths of the bad and good wires then the following formula applies:

$$\frac{R''}{R'} = \frac{L'}{L''} \text{ or } L' = \frac{R''}{R'} L''.$$

No allowance is necessary for the lead wires in this case unless they are very long. In Fig. 8 is shown the set-up when applied to cable measurements.

The slide wire Wheatstone bridge with a tone current and receiver is found to be very convenient for this use. In making the test the distant end should be short circuited, connecting the bad wire and its mate, as shown in Fig. 9. The

mate of course must be a good wire. The one terminal of the tone producer is grounded so that the tone current will pass through the a and b portions of the slide wire and parallel through both wires, returning to the earth through the capacities of the wires to sheath and ground. Balance for lease sound by moving the stylus along the slide wire. Since the shorter wire has the lower capacitance and the lower capitance acts like the higher resistance, A will be less than B.

The formula for the distance d to the fault is $d = \frac{2aD}{m}$ in which D = length of cable and m = a + b = divisions of slide wire.

This relation is derived from the equation $\frac{d}{2D-d} = \frac{a}{b}$.

same as for the Murray loop test. Then the following formula will apply:

$$\frac{1000 \times \text{Twice the length of the cable}}{1000 + \text{Resistance unplugged}} = \text{Distance to open.}$$

Variations of the Murray loop test for opens are shown in Figs. 11 and 12.

Direct Deflection Method

The expression "direct deflection" is used to mean any measurement in which the value or result obtained depends on the reading or deflection of the measuring instrument. The Wheatstone bridge is a zero apparatus, for in its use the galvanometer is made to have a zero reading and the result calculated from the ratios of resistances. Thus the result does not vary with the deflection. The direct deflection method employs a galvanometer to measure the quantity of electricity which the bad wire will hold under a given voltage. This is compared with the quantity which a good wire will hold. The distance to the break is computed on the assumption that the capacity of the wire is proportional to its length.

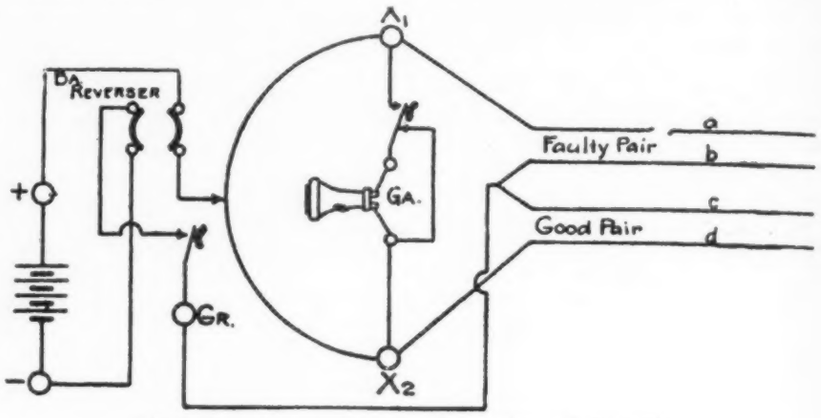


Fig. 8, Location of "Open" by Comparison of Capacities.

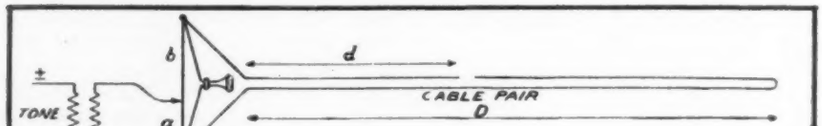


Fig. 9, Methods of Locating "Opens" in Cable.

Murray Loop Test for Opens

The Murray loop test may also be used for locating opens using a receiver instead of the galvanometer and a buzzer as shown in Fig. 10 This set is very convenient for this and other tests and may be described as follows: An induction coil is used as shown in Fig. 10, the primary coil of which has a buzzer and battery in series. The secondary coil has one side grounded and the other side connected to the point where the rheostat and bridge arms join; by starting the buzzer, the buzz will be heard in the receiver. An operator's head receiver will be found more convenient than an ordinary receiver for this purpose. Connect the open wire to a good wire at the end of the cable, connect the bridge the same as for the Murray loop test, start the buzzer going and adjust the rheostat until the minimum sound is heard in the receiver; then figure out the distance the

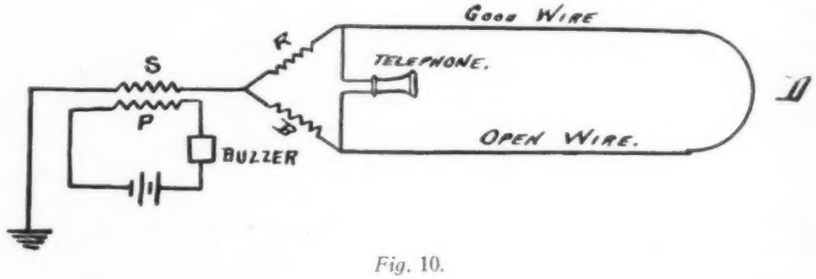


Fig. 10.

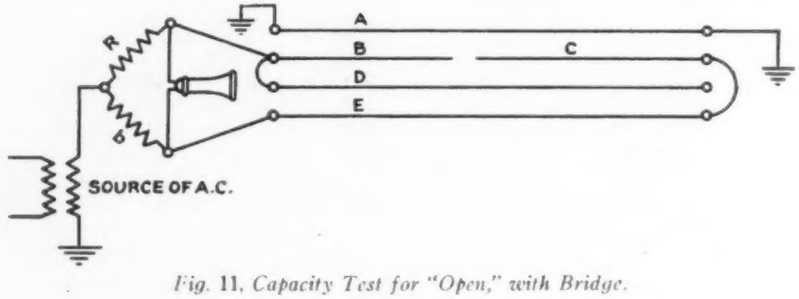


Fig. 11, Capacity Test for "Open," with Bridge.

Induction Method of Testing

In this test two methods are frequently used, both tests employing a twenty-ohm buzzer, an exploring coil, induction coil and telephone receiver. The set-up is shown in Fig. 13 for method 1. The

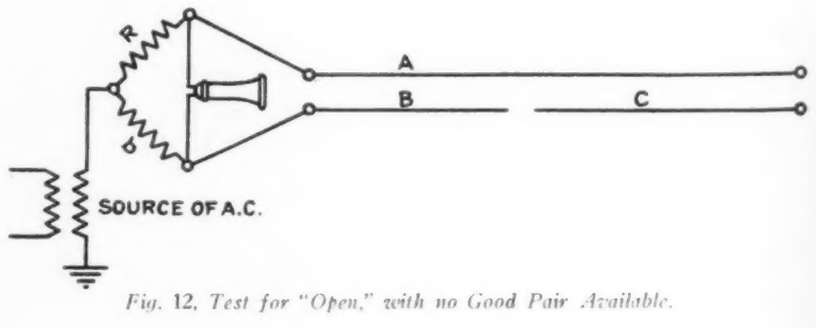


Fig. 12, Test for "Open," with no Good Pair Available.

buzzer and switch can be mounted on a box that will hold twenty batteries and the test wires connected to two binding posts mounted on the box. These tests are used principally for locating grounds, shorts and crosses. The connections for locating a short circuit are shown in Fig. 13, B. Now take a bi-polar receiver and connect a sensitive operator's receiver to

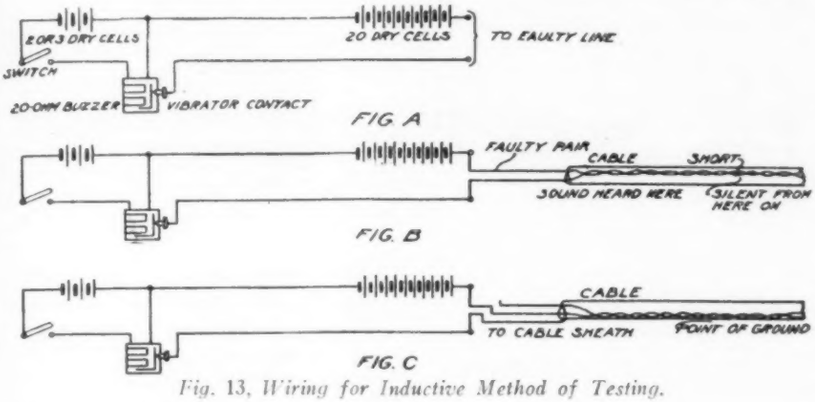


Fig. 13, Wiring for Inductive Method of Testing.

it. Remove the diaphragm and ear cap of the bi-polar receiver and use it for an exploring coil. Start the buzzer by closing the switch. The exploring coil or bi-polar receiver is then passed around the cable sheath to pick up the vibrator noise and the tone is followed until it vanishes at which point the trouble is usually found. In using exploring coils care should be taken to pass the coil completely around the cable for a distance of one or two feet so that the spiral turns of the pair may be followed in order to locate and be sure that the buzz is obtained as frequently this noise may not be heard on one side, but will be heard on the other side.

The use of the bi-polar receiver is only a temporary make-shift and it is suggested that one of the standard exploring coils, of which there are several on the market, should be used instead of the bi-polar receiver, as better results will be obtained. A fairly good exploring coil may be made up as follows: Take some No. 18 soft iron wire and make an iron core one-fourth inch in diameter and about three inches long. Wind three or four layers of No. 28 silk-covered wire on it and connect both ends to the operators' head receiver. For locating a ground the set-up is shown in Fig. 14 and use the exploring coil in a similar manner. It is not necessary in trying to make the location to climb every pole, but only about every fifth pole or the cable made be divided up into half and then quartered and the distance reduced until the location is found.

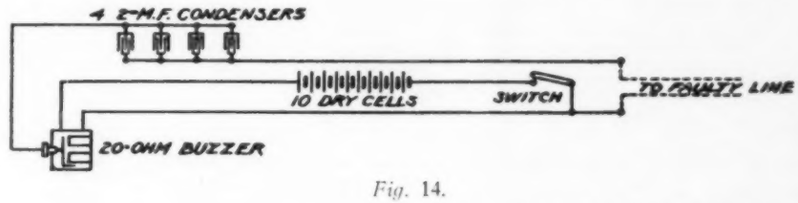
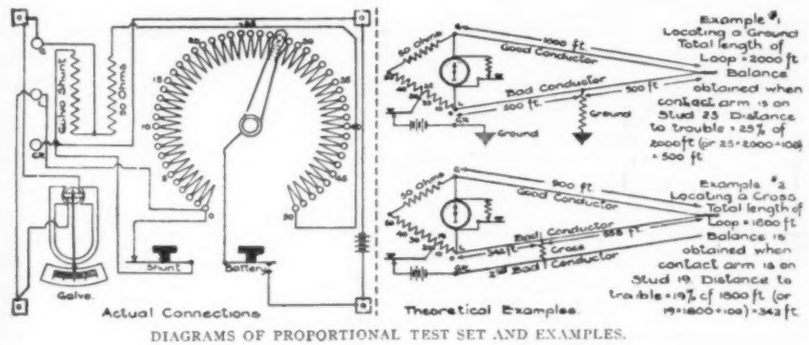


Fig. 14.


Example #1
Locating a Ground
Total length of Loop = 2000 ft
Balance obtained when contact arm is on Stud 23
Distance to trouble = 23% of 2000 ft (or 23 × 2000 ÷ 100 = 500 ft
Example #2
Locating a Cross
Total length of Loop = 1600 ft
Balance is obtained when contact arm is on Stud 19
Distance to trouble = 19% of 1800 ft (or 19 × 1800 ÷ 100) = 342 ft
Actual Connections
Theoretical Examples

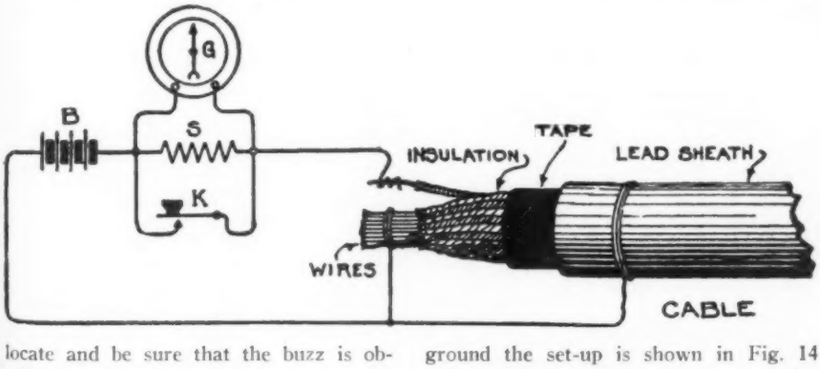
DIAGRAMS OF PROPORTIONAL TEST SET AND EXAMPLES.

Water Soaked Cable

The location of trouble due to a water-soaked spot in a cable is sometimes very difficult as there are no good wires running to the end which can be used for a loop test. If the cable is largely multipled by noting the pair numbers of all the pairs which are bad and examining the cable records, it may be found at which terminal these pairs cut out and in what section of the cable trouble exists. This will save a good deal of time in inspecting or in trying to locate the trouble. Fig. 15 shows a method of testing a cable having trouble of this kind. At the central office a fairly strong current is sent into the wires and caused to return on the sheath of the cable. As the current returns it will produce a difference of potential along the sheath, due to the resistance of the lead. If alternating current is used, a telephone receiver or exploring coil can be used to detect this potential difference. Between the central office and the trouble there will be current returning on the sheath, but beyond the bad place, there should be none. By using the exploring coil at intervals as indicated in the previous test, the trouble can be run down. If alternating current is not available and direct current is used, a millivoltmeter is used instead of the exploring coil which is shown in Fig. 16.

The table, Fig. 17, gives some idea of the current necessary. The success of this test depends very much upon making the current large enough. In this table it is assumed that the lead of the sheath has approximately a resistance eleven times that of pure copper. Enough lamps should be connected up in parallel on 110-volt circuit to give the required current. If the cable sheath is grounded we may either cut the ground wires during the test or use the millivoltmeter method and note the direction of the current flow. If the ground wires on the cable are left and the fault occurs between two of them, the return current will divide, part flowing to the nearest ground and part flowing to the next ground. The paths are indicated by arrows in Fig. 16. Hence the direction of flow of current must be carefully noted. When you reach the spot beyond which it reverses, the fault has been found.

Frequently the trouble develops in one



or more spans of cable, but the exact spot cannot be located. It also frequently happens that after having boiled out a large cable that has been wet some pairs still show moisture, and the following method is very helpful where the trouble is too light to locate by other means. Select two to five pairs that show moisture, bunch them together and connect the receiver and about ten cells of battery in series to ground or cable sheath. This may be done at the central office, at a cable terminal or at an opening in the cable. Then place the receiver to your ear and have a man ride the cable and strike it about every foot or so with a well-padded lead mallet or dresser, so as not to damage the cable. The wet cable pairs make a frying sound in the receiver, but when the wet place is struck

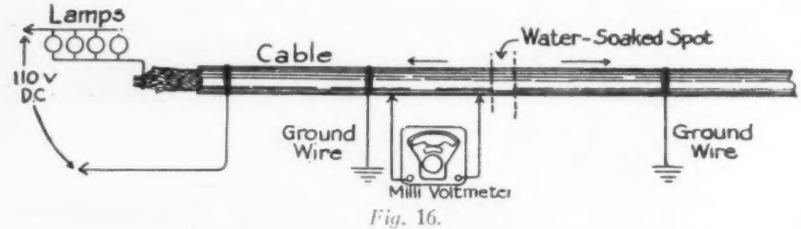


Fig. 16.

the resistance of the moisture trouble is changed and a sound is obtained similar to striking a transmitter varying the resistance.

This test is also very convenient when trouble is located in can tails and where the cable is multipled, and it can generally be determined by using one cable pair and listening in at the central office. In making this test the man using the mallet must be in touch with the tester. It is sometimes necessary to use a third man when riding the cable is necessary, one man being at the terminal, one riding the cable and one man at the office end of the cable. When the pounding noise has been heard, it is well to pound the cable for several feet on each side of where the sound was first noticed, in order to determine where the pounding noise is loudest which is the wettest place.

Locating High Resistance Cross on Line

A high resistance cross may be located by means of the Varley loop without the use of an extra wire for patching. Open the distant end of the two crossed wires as shown in Fig. 18 and measure the loop resistance which will include any resistance in the cross Z. Represent this by $L = X + Y + Z$ (1). Now ground either wire beyond the cross for example at the distant end and also ground the battery as shown in Fig. 19. When the bridge is again balanced we have $\frac{A}{B} = \frac{Y+Z}{R+X}$ (2), and from equations (1) and (2) we have $X = \frac{BL - AR}{B + A}$.

When the ratio arms A and B are equal, say 100 ohms each, $X = \frac{L - R}{2}$.

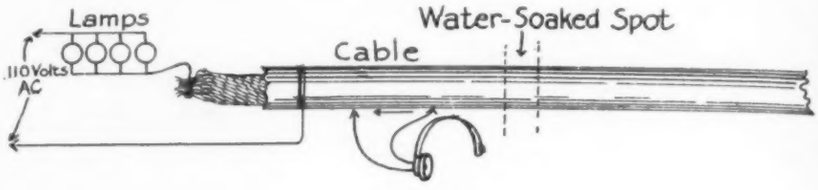


Fig. 15.

The quotient of this figure divided by the resistance per mile of the wire X gives the distance to the cross. The resistance of the two wires of course must be equal to get the best results.

Toll Line Faults

It is frequently difficult in locating toll line trouble to obtain a clear pair to read with. Hence the application of the Varley or Murray loop tests is sometimes impossible. The circuit shown in Fig. 20 is a set-up to meet this condition. Measure the resistance with one end of the bad wire measured from E through the fault F to ground G, as shown in A, Fig. 20, the value of which will be called S. Take a similar reading at the other end of the line, from H to F and G (see B, Fig. 20). This value will be called T. Representing the actual resistance of the wire from one end E to the fault F as

Cable Data	50-pair.	100-pair.
Diameter in inches	1¼	2⅜
Thickness of sheath, inches	3-32	7-64
Area of sheath in circular mils	622,600	1,226,000
Resistance of one foot of sheath, ohms	.000185	.000101
Resistance of three feet of sheath, ohms.	.000555	.000303
Current to give 10 millivolts across the three foot space, amperes	1.8	3.3

Fig. 17.

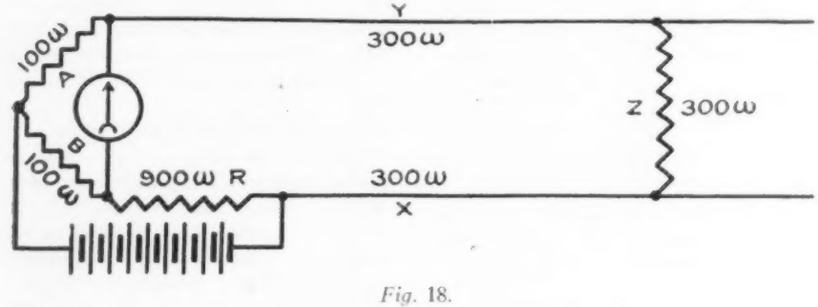


Fig. 18.

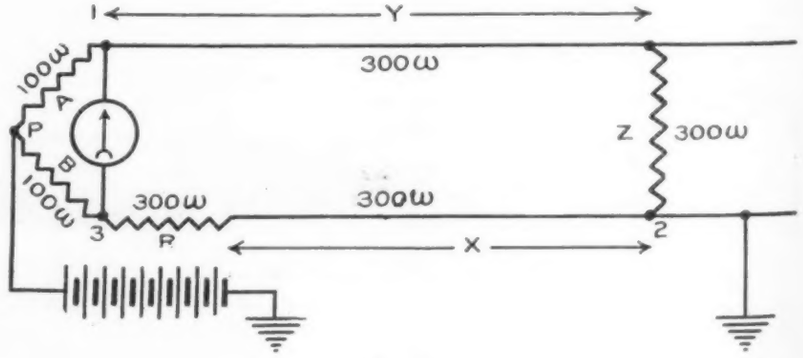


Fig. 19.

X, the actual resistance from the other end H to the fault F as Y, the resistance of the fault itself as Z, and knowing the total resistance of the faulty wire EH (either previously measured or calculated from its size and length) we have the following:

$$R = X + Y.$$
$$S = X + Z.$$
$$T = Y + Z.$$

Whence resistance from one end to fault:

$$X = \frac{R + S - T}{2}$$

or resistance from other end to fault:

$$Y = \frac{R - S + T}{2}$$

These values are independent of the resistance of the fault and represent the actual distance to the fault which can be readily reduced to feet by reference to wiring cables giving resistances per foot of the conductor. See November TELEPHONE ENGINEER, page 38.

Test Connections

Many troubles are caused on open wire circuit by poor connections at test points. It is therefore recommended where test points are necessary that the test clamp shown in Fig. 21 be used for this purpose. There is no chance of the test clamp working loose or the wires becoming loose if the jumper wire is bent back on itself and then twisted spirally and inserted in the groove of the clamp and the test clamp screwed tight and the lock nut carefully tightened up. If this method is used, the testing point should be as good or better than any other joint as it does not injure the line wire when applied or removed. It is poor policy to put more than one wire from each end in a test clamp. The illustration shows the correct method of attaching a small wire such as a drop wire to a clamp and the incorrect method of putting one wire under the lock nut which is often done.

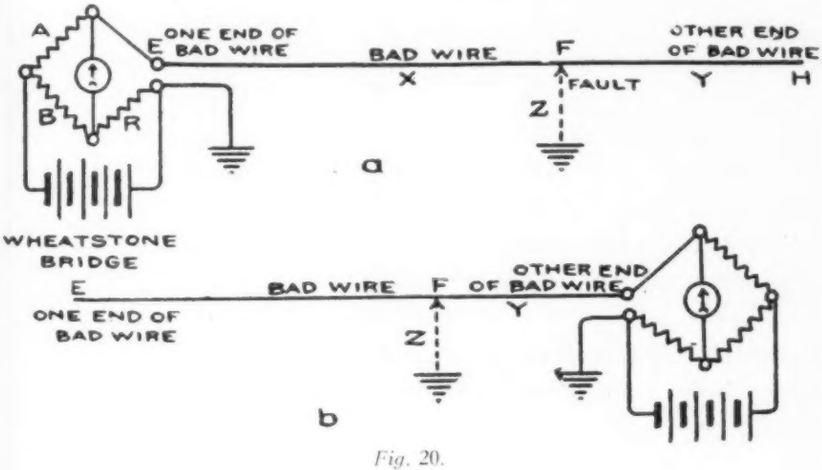


Fig. 20.

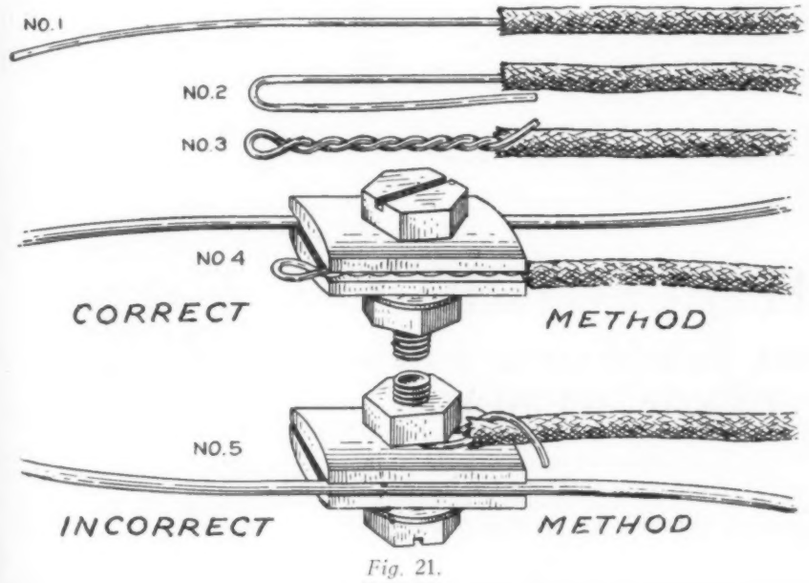


Fig. 21.

Knapp Properties Are Progressing and Paying

Norwalk, O.—Steady progress in the group of telephone properties in Ohio which are associated under the management of Frank A. Knapp, president of the Ohio Telephone association and a director of the United States Independent Telephone association, is indicated in a recent news bulletin. At Norwalk, the Local Telephone company has finished remodeling its building and installing 14,000 feet of underground conduit. New exchange equipment will be installed during the coming year. The Galion Telephone company has purchased a building which will eventually house the commercial office and the exchange of the company. A new copper toll line has been built between New Washington and Bucyrus and extensions of cable plant are planned for Bellevue, Bowling Green and North Baltimore. Regular dividends have been declared and in the case of the Local Telephone company of Norwalk, the checks represented the 93rd consecutive dividend on the preferred stock; a record of over twenty-three years of uninterrupted dividends.

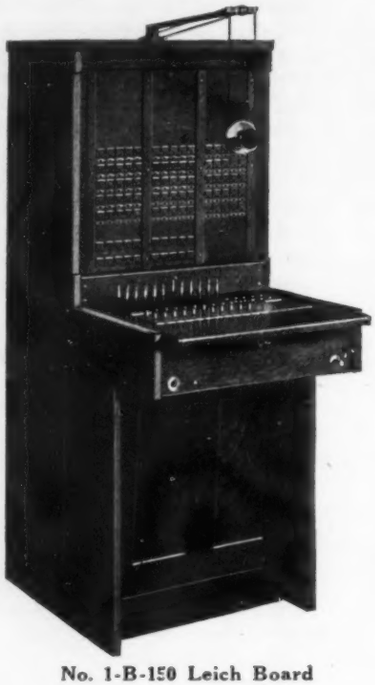
Wonder Ship to Have Great Telephone System

Philadelphia, Pa.—The largest and fastest high-powered passenger steamship ever built in the United States will have as a part of her equipment one of the most complete systems of telephonic communication ever installed in a vessel of her kind. The vessel is the 22,000 ton Malolo (Hawaiian for flying fish) which is now being constructed. When completed in the spring of 1927 she will be placed on the San Francisco-Honolulu run to make the round trip in eight days—four days less than the fastest ship now plying between the two ports.

Her service telephone system will consist of approximately 323 phones, one of which will be in each passenger and crew stateroom. All telephones in galleys, machinery spaces, and where exposed to dampness, are to be of the weatherproof type with weatherproof extension bells.

In addition to the service phones, a loud speaking telephone system will be installed for communication between the bridge, after docking bridge, forecastle, crow's nest, and main engine room. There will be a second loud-speaking system for communication between the chief engineer's stateroom and the main engine room.

Dayton, O.—Ohio Bell was host here to 50 officials and employes of 11 Independent companies operating in vicinity of Dayton. Toll line work was featured on the conference program.



No. 1-B-150 Leich Board

SUPERVISION

--Lamp or Mechanical

The choice in recent purchases of Magneto switchboards has been greatly in favor of the lamp supervision.

Invariably lamp supervision was chosen for those offices that had extremely busy periods. When operators are working at top speed an improvement that will aid them in their work has a very marked effect upon the service that can be rendered.

Many magneto exchanges are condemned because of poor service for the simple reason that the supervisory system is not adequate to handle traffic at the busy hour, while with better forms of supervision the same number of calls could have been handled very easily and with greater speed.

The new Leich Lamp Supervision is positive and reliable. In fact the system has both lamp and drops, producing the greatest possible assurance against breakdowns of the entire supervisory system.

The cost of operating lamp supervision is held to a minimum by the use of alternating current for both lamps and the restoring of the cord signal relays. Greatly increased facilities are thus provided for only a very slight increase in initial cost and operating expense.

The new lamp supervision is regularly installed in all types of magneto switchboards and is adaptable to boards now in service that have inadequate supervision.

Write for detailed information.

LEICH ELECTRIC CO.

Telephones, Switchboards, Accessories

GENOA, ILLINOIS

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ELECTRIC APPLIANCE COMPANY
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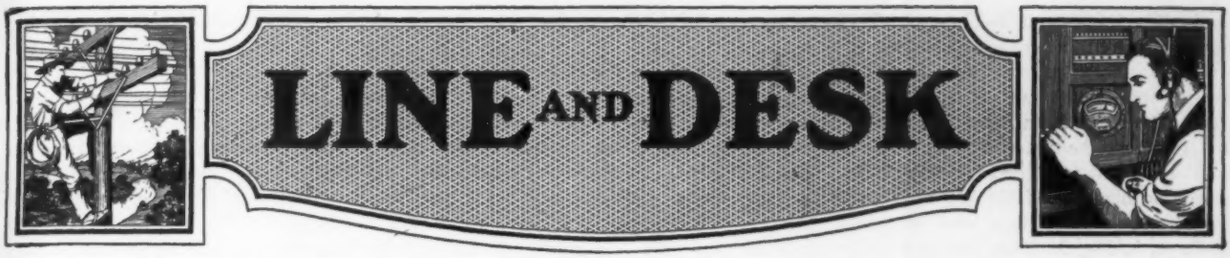


NEW USES FOR OLD EQUIPMENT

There is no doubt that in most cases common battery systems have many advantages over magneto equipment and in all cases, except in the smaller exchanges, new equipment should be of the former type. The subscriber would prefer a common battery instrument and will usually pay a higher rate for it.

Common battery has proven itself cheaper to maintain, except perhaps in some of the small outlying exchanges. However, there are many places where magneto equipment is in service, in good condition, and for various reasons should not be replaced for some time to come.

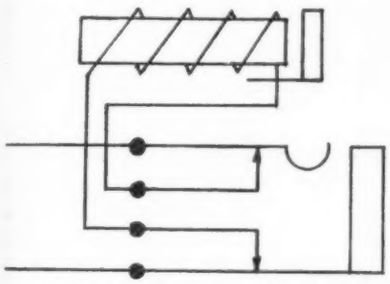


Fig. 1, Local Battery Line Circuit.

In one it was necessary to connect trunk lines from the magneto exchange to a common battery switchboard that was not equipped with ring down trunk equipment. It was therefore necessary to convert five of the subscribers' circuits as shown in Fig. 1 to trunk circuits that would work with the regular line circuits as installed in the common battery board. This was accomplished as shown in Fig. 2. Any ring through repeating coil can be used and the condenser should be about 2 MF capacity. Two additional contacts were mounted on the regular line jack that stood normally open, and closed when the plug was inserted. This short-circuited the condenser to call the operator and to give supervision. Noninductive resistance of about 200 ohms was inserted in this circuit to prevent the discharge of the condenser from damaging the contacts when it was short-circuited. This functions very satisfactorily even though the only supervision is from the ring off of the magneto subscriber.

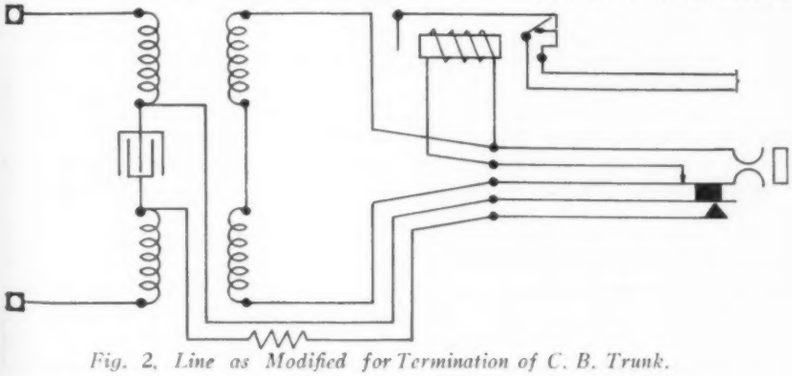


Fig. 2, Line as Modified for Termination of C. B. Trunk.

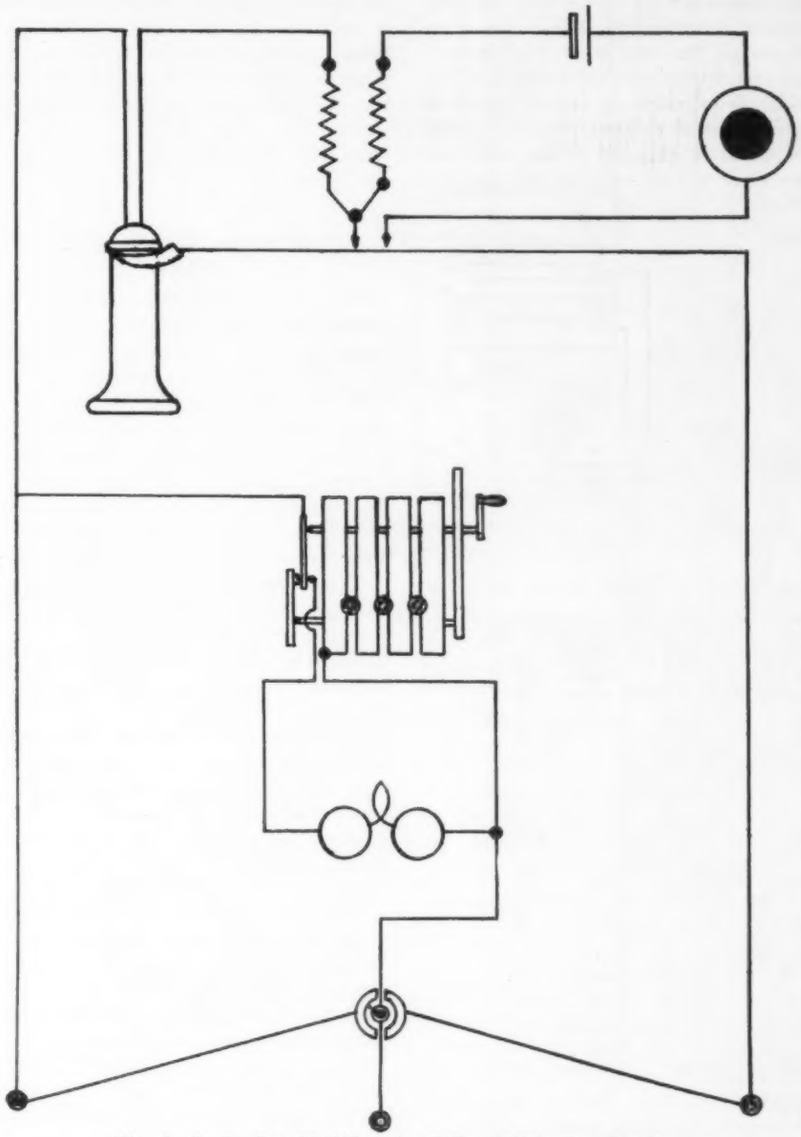


Fig. 3, L. B. Set Modified for 2-Party Selective Service.

In another it was necessary to hook up several two-party selective lines. The switchboard was not equipped with reverse ringing keys so jack per station was

used. The line circuit as shown in Fig. 1 was converted to the circuit as shown in Fig. 4. These changes were made by opening the tip and ring at one jack and cross connecting from the other so that the circuit can be restored to its original hook up with very little trouble. By grounding one side of the bell and hand generator the substations were changed as shown in Fig. 3. This change permits one subscriber to signal the operator without disturbing the bell of the other station on the same line. The operator can also determine which party is calling which is of value on certain classes of service such as restricted toll, etc. When the operator plugs in either jack both drops are cut off.—Contributed by Ray Blain.

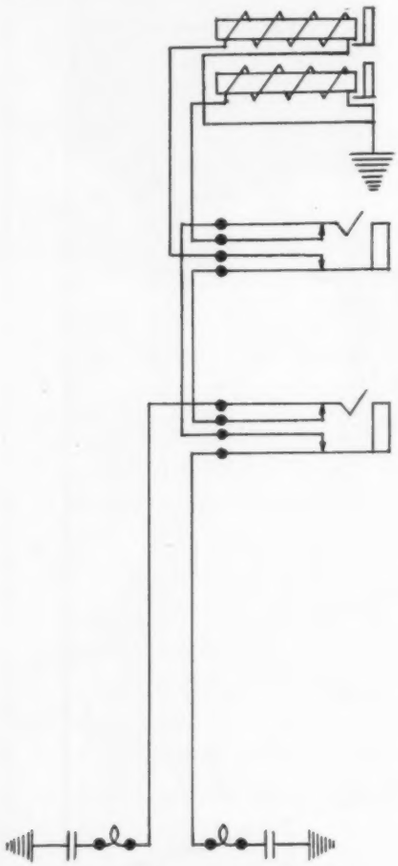


Fig. 4, L. B. Line Current Arrangement for 2- Party Selective Service.

SAVINGS IN USING TREATED POLES

Engineers and economists are realizing more and more the value of treated poles, but certain uneconomic practices still are effective. One of these is the use of small untreated poles over a short period of years because of necessity of replacement later, due to heavier requirements. It has been considered cheaper to abandon the old lines, providing new poles for the new requirements. In the spirit of conservation, it would be economic to pull up these small poles and set them somewhere else. This, of course, would not be possible if the original poles were untreated.

Of course, from the dollars-and-cents urge or pocketbook rule, the use of treated poles means a higher initial cost; but this is really economy, and the engineer with vision can convince the financial executive that treated poles defer the time for replacement, that the cost per pole per year takes a big drop and financial problems become less troublesome by at least one big item. To save a little initial expense by using untreated poles is to throw poles away. In other words, the use of treated poles is like spending an extra dollar now to save two dollars later.—W. H. Bancker in "Western Electric News."

PLANNING EASEMENTS AHEAD

Referring to our editorial suggestion in August, that rear property easements be provided in new real estate subdivisions for utilities. We have the following interesting letter from C. W. Kugelman, plant superintendent of the Portsmouth (Ohio) Home Telephone Company:

"There appeared in the August issue of TELEPHONE ENGINEER an interesting editorial on "Rear Property Easements." Your points were well put and I have been intending for some time to compliment you on the issue as a whole, as it contained many good features.

"Here are a few thoughts along this line which came to me while reading the editorial:

"The territory in which we are operating is growing very fast. New additions have been added and accepted by the city faster than we could keep tab on them. In many cases we were able to get in and have easements or rights of way provided; but two small additions got by without our knowing they were ready, so we proceeded to get busy and asked the city council to pass an ordinance making the providing of easements compulsory before the plats could be accepted; we also advanced the idea of a City Planning Commission, which is possible under our state laws.

"The council appreciated the situation and took immediate action, passing one ordinance providing for easements and another creating a city planning commission. This commission consists of the mayor, three members appointed by the mayor, together with the director of public service and the city engineer. All real estate dealers and land owners are favorable to both ordinances as they as well as we do not want the streets lined with poles. In some instances the arrangement is not satisfactory to the power company, but so far there has been no serious trouble.

"In your editorial you mention a strip one or two feet wide. This is hardly wide enough, particularly when one considers that underground conduits and distribution poles cannot be placed and maintained in such a small place or space. Again it will be necessary for crews and troublemen to enter such places at different intervals and many people object to workmen passing over their lawns, particularly with poles, wire, etc. We therefore requested that an eight-foot strip be provided where the easement is between two streets, or four feet when lots are so located that only one street is laid out. Should another street be laid out in the rear of the first street four feet are to be reserved to line with the first allotment. This space, if properly proportioned, will carry all utilities, namely; telephone, gas, water, light and small sewers. Large sewers and water mains are generally located in the streets. Telephone and light wires are to be planned for joint construction.

"We find it a good plan to work in with the city dads and real estate people as we all have several things in common. A plan is now being worked out whereby the public service director and city engineer will have full supervision in locating the property of the different utilities. Most of the larger city's utilities are subject to that supervision now."

"BUFFALO TOLD ME."

Section Lineman F. E. Chickering alias Mr. Fixit, A. T. and T. Company representative at Hornell, N. Y., relates an amusing incident which occurred on the Scranton-Buffalo line, about sixty miles from Buffalo.

The State of New York was making a road change at pole 6,800, near Dalton, and the Irish foreman in charge had used dynamite extensively in removing obstructions. On this particular day he had decided to use a generous amount, in defiance of obstinate rocks and boulders. The answer to it all was a line failure of ten wires, and Chickering was dispatched to pole 6,800 to perform the usual stunts.

Chickering, in his tin-type of a real auto, challenged all traffic regulations and covered the twenty-four miles in jig time. Upon his arrival at the scene of destruction he cautiously reproached the foreman for not advising him of his intention to blast; that the occurrence had cost the Company considerable inconvenience.

Somewhat abashed, the Gaelic overseer remarked, "How did yez get here so quick?"

"Why," replied Chickering, "Buffalo told me about it."

After a moment of doubtful thought, the foreman exclaimed, "Gosh! I didn't think they could hear it that far."—R. L. B. in "Long Lines."

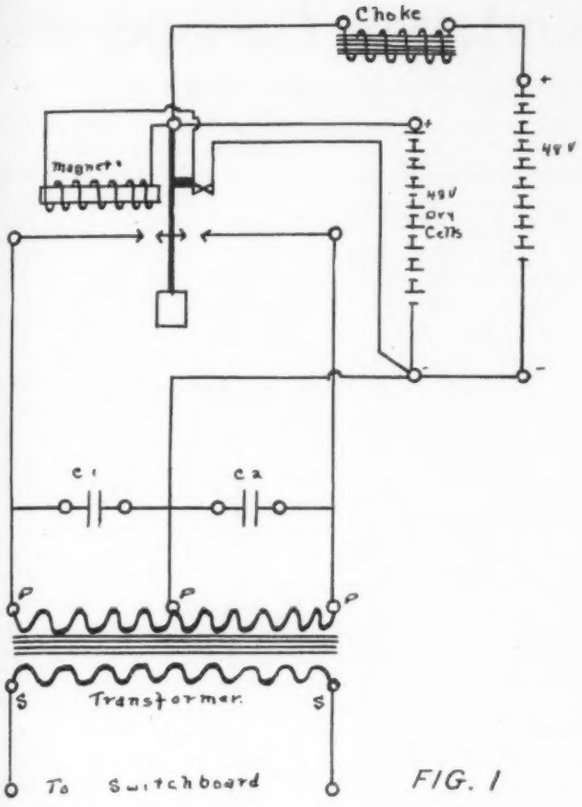


FIG. 1

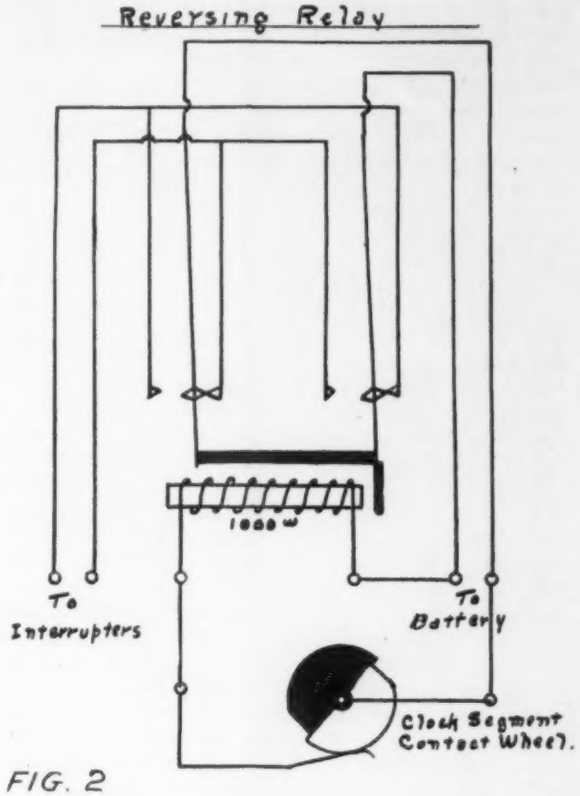


FIG. 2

Interrupter Trouble and the Cures That Correct It

By E. R. COLLINS,
Toll Wire Chief, Manitoba Telephone System

In the October issue of TELEPHONE ENGINEER, in the "Line and Desk" Department, appeared an inquiry relative to ringing interrupter trouble. It is assumed that the ringing set in question is of the harmonic type, operating from the central office storage battery. The usual circuit arrangement for such a set is shown in Fig. No. 1.

The interrupter set is apparently operating correctly, except when the contacts stick, or give trouble. This is to be expected, as the excessive flow of current, over sticking contacts, will cause such a fall of voltage across the interrupter sets, which are all fed through a common choke coil, that some variation in the frequency of the other vibrators of the set is bound to occur. Granted the contacts are in good condition the operation of the whole set will be satisfactory.

There are five main causes for contact trouble.

1. Unbalance in the primary windings of the transformer.

2. Incorrect condenser capacity bridged across the primary windings of the transformers.

3. Improper adjustment of the frequency pendulum, to work with the transformer and condenser arrangement.

4. Poor condition of balancing battery.

5. Failure to reverse the battery feed at regular intervals.

The two windings of the primary of the transformer should be absolutely balanced. A Wheatstone bridge measurement should not show over ½ ohm difference between the two coils. Any greater difference should be investigated, as it will cause considerable arcing at the contacts of the low resistance coil.

Across the primary winding of each transformer will be seen a condenser. Each frequency will call for a special build of transformer, and special capacity of condensers. While condensers of another capacity might work, there will be found only one capacity that will work best. Too much or too little capacity will result in excessive arcing at the contacts. An arc formed as a result of too much capacity will have a bluish color. It will be more satisfactory to order the proper size of condensers from the manufacturer of the interrupter, stating the capacity specified, type of interrupter and the frequency on which it will be used. It is a good plan to have some spare condensers in stock for repairs. These condensers should have the capacity painted on them as soon as received to eliminate any chance of error.

It will be seen from the above that the transformer and condensers have a definite relation for a given frequency. It also follows that the interrupter pendulum must vibrate within a close margin of this frequency. For instance a 33 cycle transformer and condenser set will not operate satisfactorily with a 16 cycle vibrator unit. The weight on the pendulum of the vibrator unit is set for a definite period of vibration. Do not change this under any circumstances, after a set has once been properly installed. Any change in frequency will most likely originate from some change in battery voltage, or spring adjustment. But the pendulum should not be altered, unless of course the weight may have shifted on account of becoming loose.

Dry cells are frequently bridged across the battery feed choke coil as shown in the drawing. These batteries must be kept up to proper voltage. They prevent the counter E. M. F. of the choke coil from firing back across the interrupter contacts, but do not introduce noise into the storage battery. The voltage of the dry cells should equal the voltage of the operating battery.

Last but not least comes the reversing of the battery supply at regular intervals

This *must be done with regularity* to get the best work out of the interrupter set. It is a well-known fact that direct current flowing over vibrating contacts constantly in one direction will cause the one contact to build up and the other to be torn down. The trouble with this process is that the wear is of a very irregular formation. So irregular is this that contacts will stick or freeze in a very short time. Even eliminate the spark at the contact, the process still goes on. We will suppose that we allow the process to build in one direction for a minute and then reverse the process, and allow it to replace what was taken off for a similar period, the wear should be very slight. The writer tried this on a set of interrupters doing heavy duty in an automatic exchange over a period of five years. The results have been much better than anticipated. Contacts which formerly lasted from two weeks to a month now last almost two years. The wear is very even with no sign of pitting of the contact faces. The only indication of wear is a little platinum dust thrown off. On a test one interrupter was run for 8 months without being changed or altered, and at the end of that period the contact faces had worn down evenly, with only a slight rim raised around the edge of the moving contacts.

The circuit, Fig. 2, used to take care of the reversing, is quite simple. A reversing relay of liberal sized contacts, and wide range of spring movement, is necessary, to provide necessary battery supply, without arcing at contacts, or introducing any excessive resistance in the battery circuit. We used an 84 B. interrupter, from which the coils and condensers had been removed and the operating magnets rewound to 1,000 ohms. The relay is operated through a segment wheel in the office clock, making contact for one minute, and breaking for the next minute. A good jeweler will be able to fit up such a contact. No noticeable interruption can be observed in the ringing current due to this relay operation. The period of reversing is optional, so long as the periods are of equal duration.

We believe such an arrangement would materially reduce the troubles experienced, as outlined in last month's issue, provided of course that other defects have been removed.

Jasper, Ark.—J. T. Spencer has sold the Jasper Telephone property to Glen Phillips, who now is managing the property.

Lorain, O.—The Lorain County Telephone company has bought the Vermillion Telephone company.

Philadelphia, Pa.—For the first time since 1915 the Bell Telephone company of Pennsylvania is advertising for new subscribers.

M. I. T. and Bell Co-operate

New Co-operative Educational System Started

Boston, Mass.—With the opening of the fall term, the Massachusetts Institute of Technology takes another important step in carrying out its policy of maintaining the closest possible contact with the industries of the country. Arrangements have been completed with the Bell telephone system by which a limited number of students in electrical engineering will be given an opportunity to get thorough first-hand knowledge of the manufacture, operation and development of the most modern electrical systems of communication including wire and wireless telephony and telegraphy.

By this new arrangement, a carefully selected group of students who have successfully completed the first two years of the regular course in electrical engineering at the Institute, or the equivalent at other institutions, will be sent to New York. For four months they will be under the direction of the Bell Telephone system. During part of this time they will be put to work in the Western Electric Company's plant at Kearny, N. J. (just outside of New York City) learning the actual details in the manufacture of telephone appliances. The remainder of the time will be spent in the work of installing and conditioning telephone switchboards in the vicinity of New York City.

During all this time the students are on the pay roll of the Bell system and must turn out their day's work like other workmen, but as fast as they master one job they are transferred to another. For them it is strictly a case of "learn by doing." But this new course has another novel feature; it requires these students to attend regular Institute classes while they are on the practical assignment and since they can't very well come to the Institute, the Institute goes to them by maintaining an instructing staff in New York. The class hours will be in the evening in order not to interfere with the practical work. The subject matter for these classes will be almost equally divided between electrical theory, and such cultural subjects as the writing and delivering of technical papers and reports and study of contemporary English literature and drama.

In addition to these classes, lectures are to be given by company experts on the different phases of design, development, manufacturing and installation of telephone equipment, and the engineering, constructing, maintenance and operation of telephone plants. On each lecture the students are required to make a written report which is read and criticised both by the lecturer and by a member of the English Department of the Institute.

At the end of the four months this group of students returns to the Massachusetts Institute of Technology just in time to join their schoolmates in starting the second term's work, and another group takes their place in New York.

These two groups of students will spend the alternate terms at the Institute and on the job in New York City where they will complete their practical experience by doing actual telephone operating in the various plants of the New York Telephone Company and getting familiar with the technical and practical problems of maintaining plant and equipment.

A final co-operative period will be spent in the Bell Telephone laboratories carrying on research and studying the design and development of engineering processes and apparatus for both wire and radio systems.

The new co-operative course with the Bell system in electrical communications requires five years for its completion, the first two years being spent at the Institute and the last three being divided equally between instruction at the Institute and practical training at the plants of the Bell system.

Because of the advanced nature of the instruction and the research work of the last year, the higher degree of Master of Science in electrical engineering as well as that of Bachelor of Science is conferred upon those who successfully complete the course.

Additional High Speed Toll Service

New York City—The high speed long distance telephone service has now been extended to Detroit, Pittsburgh, Cleveland, Washington, Baltimore, Boston, Worcester, Springfield and Providence. Telephone calls from New York to any of these cities are connected in nearly every case in five minutes or less. In its announcement of the inauguration of the new service, the telephone company says: "Long distance service is being developed along the lines of greater speed of connections and greater assurance of uninterrupted service. The increased speed has been secured through new operating methods which first were put into effect last Spring on calls between New York and Chicago. The result was to furnish the fastest service of its kind in the world on calls between these two cities. Facilities now have been made available for providing this same service between New York and nine other cities as well as Chicago."

The "Kick" that Comes of Quality

The VICTOR Dry Battery, in testing and talking, tells its own story—tells it plain, strong and steady.

Yes, sir, you get a genuine "kick" out of Victor dry batteries—

You get the thrill and joy that come of their long life and perfect service.

And that's the only kind of a "kick" there is to the Victor.

Customers of Victor save a lot in time, trouble and correspondence; they make money in getting and holding satisfied subscribers; they create a reputation for the company that cannot be measured in dollars and cents.

Victor Insures

1—The densest compound of any battery—made to a formula that is the greatest achievement of the dean of dry battery makers.

2—The thickest zinc shell, special paste and liners to prevent action within the shell, and an array of other construction features without parallel in battery construction.

3—Quick service from reliable jobbers, and thorough co-operation from our office and factory.

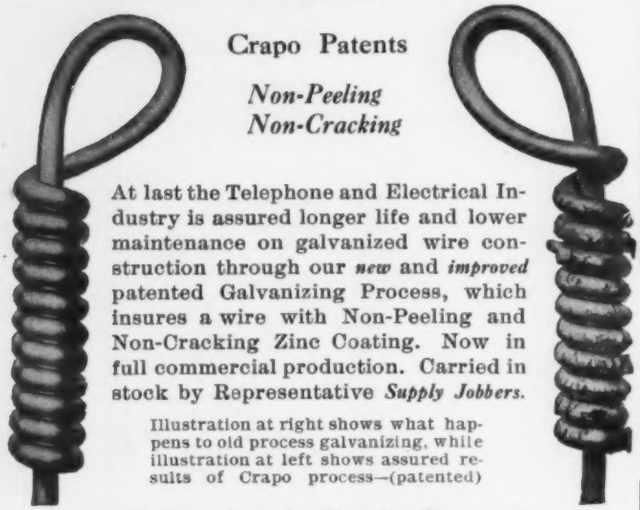
Get in the Victor line-up for 1926. It's an all-American, championship aggregation, named by all the leading experts.

Details of your nearest jobbers; or of us, direct.

THE CARBON PRODUCTS COMPANY, Lancaster, Ohio

"INDIANA"

Double Galvanized Telephone and Telegraph Wire



Crapo Patents

Non-Peeling
Non-Cracking

At last the Telephone and Electrical Industry is assured longer life and lower maintenance on galvanized wire construction through our *new* and *improved* patented Galvanizing Process, which insures a wire with Non-Peeling and Non-Cracking Zinc Coating. Now in full commercial production. Carried in stock by Representative *Supply Jobbers.*

Illustration at right shows what happens to old process galvanizing, while illustration at left shows assured results of Crapo process—(patented)

Galvanized Steel Strand

Standard or Commercial, Siemens-Martin, High Strength and Extra High Strength Grades

Indiana Steel & Wire Co., Muncie, Ind.

American Steel & Wire Co.'s W. & M.

Telephone Telegraph Wire

STRAND STEEL WIRE

POLE STEPS

Descriptive Literature—free

American Steel & Wire Company

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STANDARD

Paper Insulated Telephone Cables

STANDARD

are so protected mechanically and electrically as to insure the highest quality of service with a minimum expense for upkeep. For further information write our nearest office.

Standard Underground Cable Co.

BOSTON	WASHINGTON	CHICAGO
NEW YORK	DETROIT	PHILADELPHIA
PITTSBURGH	ST. LOUIS	SAN FRANCISCO
ATLANTA	KANSAS CITY LOS ANGELES	SEATTLE

FOR CANADA: STANDARD UNDERGROUND CABLE CO. OF CANADA, LIMITED HAMILTON, ONT.

BRACH VACUUM ARRESTERS

at prices within your reach

When the best protection costs no more, why not have it? BRACH arresters insure; non-grounding of lines, cables, clear transmission, balance of potential between pairs, and full protection against power crosses or lightning. There are no carbons to clean and no maintenance bills.

You can readily afford BRACH Vacuum Arresters at our present low prices. Type 440, showr above, is furnished with porcelain base, fuses and mountings.

L. S. BRACH MFG. CO.
NEWARK, N. J.

"Cope"

Established 35 Years

Specialties

are the standard for underground cable construction work

Send for Catalogue

Manhole Guard Rails
Cable Reel Jacks
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"Out o' Luck Without Truck"

Vital Part Played by Motor Truck in Telephone Work Detailed by White Man — Brute Is Cross Between Elephant and Mountain Goat—Workers' Rolling Home

By J. W. SPAULDING

Somewhere has been pictured a dark street of a sleeping town, and underneath this sentence: "In the dead of night the American turns to his telephone, confident he will find it ready for the emergency; he knows that telephone exchanges are open always, the operators at their switchboards, the wires ready to vibrate with his words."

It pictures something so familiar that it is taken for granted, like any other ordinary circumstance of life. No town, no household, no person is isolated; distance and time are vanishing things.

A casual glance from a train window or an automobile takes in lines of wire. These are the vital lines thrust through forest and marshland, over mountains and desolate regions, where travel may be impossible but talk is not. Yet someone had to penetrate such untraveled country to build the lines, and someone must go there again and again to keep the lines in order against all emergencies.

Long before the air mail pilots became celebrated for their slogan about how the mails "must go through" regardless of violent weather and darkest night, the telephone men had their creed, in their own language: "Keep the lines working in spite of hell, high water, snow, sleet, fire, riot, ruin, acts of man and Providence."

All of which requires, besides constant and often strenuous human labor and specialized skill, efficient motor transportation. Telephone and telegraph progress in the United States and Canada may be accurately measured by the growth of White trucks in this service. There was one White truck in telephone service in 1911. Now there are 1,300. On January 1, 1925, the 17 Associated Bell Companies, including the parent American Telephone & Telegraph company, operated 1,183 Whites, with additions being made constantly to the various fleets. Thirty-five other telephone and telegraph companies also operate White trucks, many in fleets and a number in single installations. White trucks stand first in telephone transportation. Five companies operate more than 100 Whites. These trucks are in use everywhere, a part of the vast system of 15,000,000 telephone stations, 35,000,000 miles of wire, and a personnel of more than 270,000 employes.

Build the Lines to "Mammy"

Down South there is a typical picture. In this region of nearly half a million square miles, with a sixth of the population of the United States is an unique topography individually characteristic of the South, where the creation and maintenance of telephone service is a test of engineering resource and the efficiency of mechanical equipment.

Transportation of men and materials in the construction and maintenance of the thousands of miles of pole lines calls into service 169 White trucks in addition to other automotive equipment. Seventy-five of these Whites are operated by the Cumberland Telephone & Telegraph Co. in Tennessee, Kentucky, Louisiana and Mississippi, while 94 Whites are used by the Southern Bell Telephone & Telegraph Company in the states of Georgia, Alabama, Florida and North and South Carolina.

Ever since 1914 these trucks have been dependable cogs in the telephone machinery of the South. Now the associated companies in the southern group use Whites in every one of the eight divisions in as many states.

Extend the lines! More exchanges, more pole lines, more miles of wire! The call always is urgent as growing rolls of subscribers press the commercial depart-

1—Truck Brings Everything to Job. 2—Saving in the Yard. 3—Thrift, Speed, Ease; in Contrast to Old Way.

ment and the "talk load" bears down upon the traffic department; the call for action is upon the plant department, and the fleet of White trucks is kept on the move. Recently—with the inevitable increase taking place—the records showed almost 900 city and town exchanges and nearly 650,000 stations distributed through the nine states. Behind this service were 15,000 employes.

More than a third of the 169 White trucks in service in the eight divisions are equipped with winches. Winches and portable pole derricks—two of the most valued aids in the peculiar needs of telephone work—make the trucks so equipped indispensable for heavier and more difficult construction jobs. These are used for snaking and setting poles, stringing messenger wire, and the pulling in and setting of underground and aerial cable; it is estimated that the winch operation on each truck saves the expense of one man of a crew. The other Whites are generally employed on construction work, such as stringing wire, putting on crossarms and setting small poles with blocks. They are also used in the installation and removal of telephones and in many instances for the clearing of exchange and toll line trouble, and as a general utility tool for any emergency.

These trucks work under the severest handicaps in the roughest country of mountain and backwoods, where roads are virtually unknown and mud is an ordinary hazard. Some work in city construction. Mileage, therefore, varies greatly according to the type of work to which they are assigned. Most of the trucks average from 6,000 to 9,000 miles a year, although some, usually those in small areas of city operation, may not exceed 3,000 to 4,000 miles a year. In such cases, however, where there is no requirement of high mileage, the truck is in continuous operation, for the engine is at work running the winch while the truck is standing still.

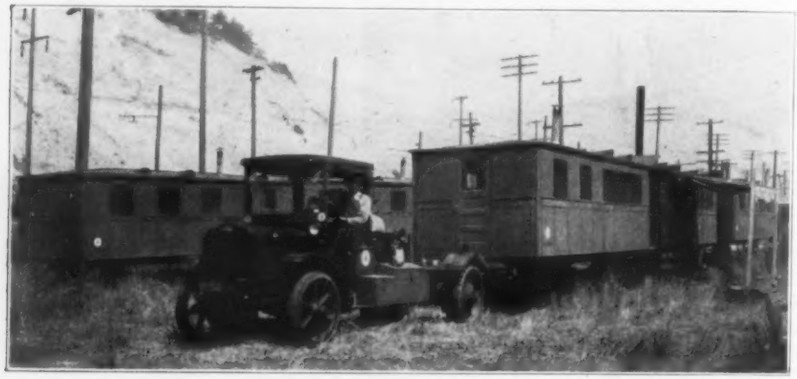
The oldest White trucks in the Southern Bell fleet are two put into service in the Tennessee division in 1914, which recently were reported still on the job in station installation work, which does not take them far afield, with mileages of 39,000 and 33,500. Some Whites in other divisions which started in 1917 and 1915 have done around 70,000 miles, mostly in wire stringing service.

Trucks Are Homes on Job

And out on the Pacific Coast these motor trucks have wrought a complete change in the lives of telephone toll line construction men of the Pacific Telephone & Telegraph Company on jobs away from the centers of population of the Pacific Northwest. No longer do they wonder before starting out where they will eat and sleep and what kind of accommodations they will find. Now, thanks to flexible transportation and engineers of the Pacific Telephone & Telegraph Company, they have their permanent home that travels with them along the route.

Construction gangs, which usually employ 20 to 25 men, have their own bunk houses and cook outfits, designed by P. T. & T. engineers. These bunks and dining cars are mounted on trailers and hooked to a White truck which moves five or six units at a time whenever it is moving day. In the past the men often had to ride 15 or 20 miles in going to work each day. Satisfaction of the company and the men with operation of these trains is evidenced in the fact that labor turnover has been far lower under the new arrangement.

In designing the sleeping cars the company overlooked nothing that would add to the comfort of the men. Each car has eight roomy berths, wash basins, stove and gasoline lights. These offer sleeping accommodations that would be hard to improve upon when compared with the average small town hotel. The cook outfit also takes exceptional care of the telephone boys, because the company knows that their efficiency depends on their health. A sample noon-time lunch: mashed potatoes, creamed carrots, beef, string beans, home-made bread, real butter, coffee or tea and choice of pies or pudding. All this at a saving to the company and still far better than in the old



Telephone Construction Gang's Bunk Houses Hauled by White Truck.

Stromberg-Carlson's Showing

As usual, Stromberg-Carlson had a handsome layout at the National Independent Convention, two views of which are shown here.

The apparatus shown at the bottom, from left to right, is as follows: Stromberg-Carlson Super-Service Switchboard; Stromberg-Carlson No. 1155 *Wall Telephone with associated No.* 1156 *Desk Set Boxes; No.* 986 *Desk Stand resting on the No.* 102 *P. B. X. Switchboard. At top, from right to left: No.* 602 *Art Console Receiver; a Western Electric cone type loud speaker; a panel of telephone construction material and supplies.*

days when the men were forced to stop at the roadside restaurant.

Operation of these motorized trains speeds up the work of maintenance for the telephone company in the state of Washington and helps keep the men contented. It is a great contrast to the days of under-powered horse-drawn equipment before the Pacific Telephone & Telegraph Company owned 100 White trucks. Most of the trucks, of course, are engaged in setting poles, running lines and the other more common construction and maintenance jobs that daily confront utilities men, for it only takes one White to move camp when the toll line crew has completed work at one point and is ready to push on to the next.

Walter H. Trimm a Successful Manufacturer of Radio Accessories

Chicago, Ill.—Another young pioneer of the telephone business has forged to the front in the radio field. Walter H. Trimm, for many years one of the head men of the Monarch Telephone Mfg. company, now is a prosperous manufacturer of radio accessories at 24 South Clinton street, Chicago. Among his leading specialties are loud speakers, headsets

and phonodapters, made in various styles and sizes. Carrying out his old policies as a telephone manufacturer, Mr. Trimm has established an enviable reputation for his products and the growth of his business has led him recently into larger quarters and a general advertising campaign. A prominent radio expert recently volunteered the opinion that the Trimm line gave him the most satisfactory service of any he had used. He was especially enthusiastic about the results he got from the popular priced horn illustrated and described herewith:

"Home speaker, model 25, has the gooseneck type horn, with a diameter of 12 inches at the bell. This Home speaker has a factory-regulated diaphragm that assures maximum volume with beautiful tone. It is designed for the smaller, low powered radio receivers, requires but little B battery potential, and makes for economical yet satisfactory loud speaker reception. Model 25 stands 18 inches high. No tinny noises or overtones are heard on this Home Speaker."

Easy to See Why the
UNIQUE FURNACE
is preferred

PATENTED SEAMLESS TUBING COIL GENERATOR
IMPROVED ONE PIECE BURNER
PATENTED ARRANGEMENT FOR DISLODGING COIL WITHOUT TEARING DOWN FURNACE
HAND HOLD FOR CLEANER ONE TURN CLEANS ORIFICE
AUTOMATIC ORIFICE CLEANER
AUTOMATIC PUMP INSIDE TANK
16 GUAGE STEEL TANK WELDED BOTTOM

Many of the foremost Bell and Independent companies have standardized the Unique Furnace. It melts 50 lbs. of lead in 10 minutes. An automatic orifice cleaner assures continuously efficient operation. It's sturdy and simple.

"UNINTERRUPTED SERVICE"—the result of a "UNIQUE DESIGN and BETTER CONSTRUCTION."

Literature ready—BLOW TORCH and Furnace.

UNIQUE MFG. CO.
113 N. Des Plaines St. Chicago
CHOICE OF THE LEADERS

RECONSTRUCTED EQUIPMENT

Stromberg No. 6½ M. F. Condensers @	$ 0.25
Monarch or Am. Elec. Local Battery Ind. coils @	.35
Western Elec. Co. No. 305 type hotel sets with 2- or 3-bar Generators, 1000 or 2500 ohm ringer equipped with No. 250 Transmitters and 122 Rec. Can supply the above with Biased attachment on ringers without extra chg. @	6.50
Western Electric No. 250 Transmitters complete with mouthpiece and back @	1.35
Kellogg Local or C. B. Transmitters, complete with back and mouthpiece @	1.10
Stromberg-Carlson No. 896—4-bar, 1600 ohm Bdg. compacts @	8.50
Stromberg-Carlson No. 599—4-bar, 1600 ohm Central checking Bdg. compacts @	7.25
Stromberg-Carlson No. 599 type 4-bar 1000 or 1600 ohm Bdg. compacts @	7.00
Monarch 3-bar, 1000 or 1600 ohm Bdg. compacts @ $7.00—4-bar $7.50—5-bar @	9.00
Garford Pony type 4-bar, 1000 or 1600 ohm Bdg. compacts @	8.50
Am. Elec. No. 36 3-bar 1000 or 1600 ohm Bdg. compacts @ $6.50—4-bar @ $7.00—5-bar @	7.75
Kellogg No. 2805, 3-bar, 1000, 1600 or 2500 ohm Bdg. hotel sets @	7.00
Dean or Garford 3-bar, 1000 or 1600 ohm Bdg. desk sets @ $8.75—4-bar @ $9.25—5-bar @	10.25
Monarch 3-bar 1000 or 1600 ohm Bdg. desk sets @ $8.50—4-bar @ $9.00—5-bar @	10.00

REBUILT ELECTRIC EQUIPMENT COMPANY, Not Inc.
E. C. Stoeffhaas, Mgr.
1940 W. 21st Street, CHICAGO, ILL.
We are not connected with or successors to Rebuilt Telephone Equip. Co.

Sao Paulo, Brazil—Brazilian Telephone Company, in which Canadian capital is interested, has been awarded an exclusive contract for supplying telephone service to Sao Paulo, by the state government. It is reported that a protest against the award is to be registered with the state council.

The Western Electric Co. announces the appointment of E. P. McGrath as sales manager of their Brooklyn Supply House. Mr. McGrath succeeds W. D. Koch, transferred to the Sales Department of the Western Electric Boston Supply House.

HK

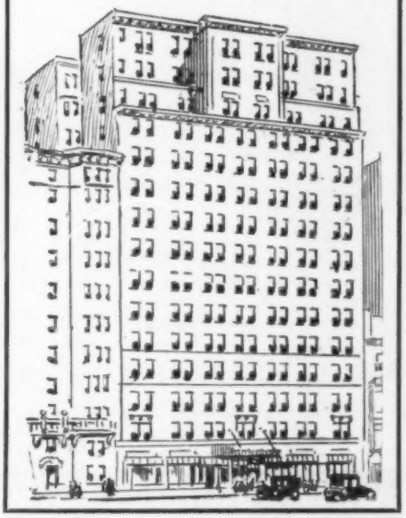
Hotel
Knickerbocker
120-128 West 45th St.

Just East of Broadway, Times Square

New York's Newest Hotel

A location unsurpassed. A few seconds to all leading shops and theatres. Away from the noise and bustle and still convenient to everything. Between Grand Central and Pennsylvania Terminals.

RATES
$3 to $5 per Day
400 Rooms—400 Baths



Pennsylvania Plans Joint Meet With U. S. I. T. A.

Harrisburg, Pa.—At a meeting of the board of directors of the Pennsylvania Telephone and Traffic Association it was unanimously decided to held the 1926 convention of the association in Philadelphia during the Sesquicentennial which will open about June 1, 1926. A movement has also been started to have the United States Independent Telephone Association bring the national convention to Philadelphia at the same time. The celebration of the fiftieth anniversary of the invention of the telephone will also be observed with appropriate ceremonies and an exhibit demonstrating the growth and progress of the art.

Yale, Okla.—Radio's possibilities for telephone companies was headlined at the fourth district Oklahoma meeting. J. F. Gustafson of Fredonia, Kan., a successful pioneer in this line, was the star speaker.

New York City—New York Telephone Company increases capital stock from $325,000,000 to $450,000,000.

Omaha, Neb.—"The Bell telephone system is run on the narrow profit margin of less than one cent per telephone per day, Walter S. Gifford, Bell president told the Greater Omaha association.

Council Grove, Kans.—Mutual Telephone company plans an expansion of its facilities between Council Grove and Alta Vista.

SAVE

Use Rebuilt Equipment

Strowger Dials
A. E. Ringers—Straight or Harmonic
A. E. Subsets
A. E. Dial Type Desk Stands and Wall Sets

It will pay you to get our prices before purchasing

Kendick Telephone Supply Company
CANTON, OHIO

WANTED—Copies of August, 1925. Will extend subscription 2 months for each issue. TELEPHONE ENGINEER, 28 E. Jackson Blvd., Chicago, Ill.

Everstick

Approved by Large Operating Companies For the Following Strains

6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
8" 2-way	6,000 lbs.
8" 4-way	10,000 lbs.
10" 4-way	16,000 lbs.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

$37.50 **Addressograph**

CHEAPER than typewriter—SAVES 30% of YOUR present costs—5 to 15 times FASTER and BETTER than pen or typewriter.

FREE TRIAL will prove it!

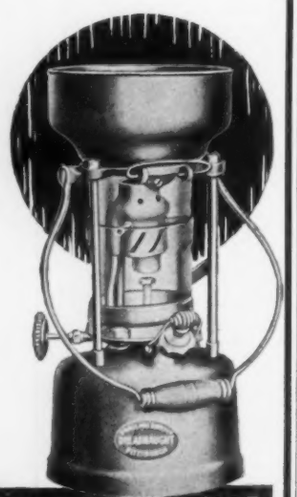
904 W. Van Buren St., Chicago, Ill.

WANTED—To buy used transmitters. 125 W. North Ave., Olney, Illinois.

The WALL "DREADNAUGHT" FURNACE

WALL SUPERIOR PRODUCTS SINCE 1864

WALL Service with Safety "Dreadnaughts" have always been favorites among furnaces of this type. Safety and durability are guaranteed by solid brazed steel construction throughout. A specially designed burner will melt 40 pounds of solder in 10 minutes and will operate indefinitely without carbon trouble. Pump can be removed while furnace is in operation.



Each "Dreadnaught" securely packed with tip for kerosene. Tip for gasoline furnished only when specified.

P. WALL MFG. SUPPLY CO.
Pittsburgh, Pa., U. S. A.

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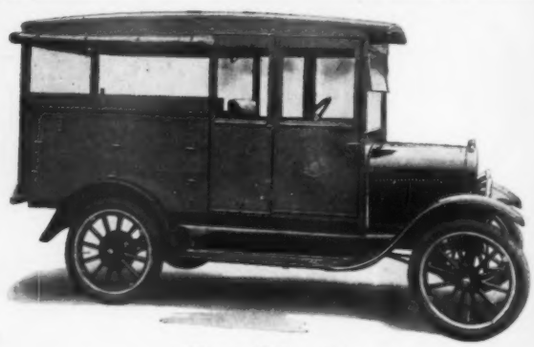

Type SC-1574

SERVICE BODY FOR FORD MODEL T CHASSIS

A STURDY, durable body, especially designed and built for telephone work. Standard equipment with many of the leading telephone companies. Body is provided with cabinets on each side, ladder irons and material hooks. Cabinets have space for all necessary articles.

Write for full description and price.

HOOVER BODY CO.

YORK, PENNSYLVANIA

When material must endure

USE STEEL

Because of this steel construction, Cook terminals have more than twice the life of wood terminals, *but cost no more.*

They will not warp, check or rot. They are not affected by climatic changes. They are lighter, stronger, and fireproof.

The assembled steel corebox, hot dip galvanized with the gasket zinc cover, offers a perfect means of terminating lead covered cable without a wiped joint or cable compound.

So it's easy to understand why Cook terminals are the most economical terminals you can use—they cost no more and they last longer.

Above is an illustration of our S-6 "All-Steel" Pole Cable Terminal. It is but one of the three types of protected terminals of "All Steel" construction we manufacture.

COOK ELECTRIC COMPANY

2700 Southport Avenue Chicago, Illinois

CONSTANTLY ROLLING UP AN EVER INCREASING NUMBER OF ENTHUSIASTIC USERS AS IT TRAVELS TO INDUSTRY AFTER INDUSTRY, THE R-B WINCH HAS DEFINATELY ESTABLISHED ITS PLACE AS THE WORLD'S LEADING TRUCK WINCH. LIGHT IN WEIGHT, BUT ITS LIGHTNESS DOES NOT KEEP IT FROM ***OUTPERFORMING*** HEAVIER, COSTLIER WINCHES OF EVERY TYPE; IT MERELY TENDS TO ***ELIMINATE*** STRAIN AND WEAR ON THE WORKING PARTS OF THE TRUCK, WHILE IN OPERATION. THE ***LOCATION*** OF THE R-B WINCH ON THE TRUCK WHEEL, LEAVES THE ENTIRE LOADING SPACE OF THE TRUCK AVAILABLE AT ALL TIMES. WRITE FOR COMPLETE LIST OF USES AND APPLICATIONS TO YOUR PARTICULAR REQUIREMENTS.

MORE THAN 60 TYPES

THE BRADEN COMPANY
An Express Trust
TULSA, - OKLAHOMA
SOLE MANUFACTURERS

THE R-B WINCH

RELIABLE BRADEN WINCHES R B

SATISFACTION

No. 202
Cross Arm Arrester

"It Works While You Sleep"

Place this arrester wherever your lives are exposed to unusual lightning conditions. Ten lines or five pairs of protection at nominal first cost.

Prices, samples and additional information on request.

Reliable Electric Company

3145 Carroll Avenue **Chicago, Illinois**

Send for This Book

Every telephone engineer and executive should have this new book, which we have just issued on creosoting processes and specifications. It is invaluable as a reference guide in specifying creosoted woods. Processes of treatment and uses of creosoted materials are fully illustrated. Send today for your copy of booklet C.

*Creo-pine is the registered trade name of creosoted pine products of our manufacture.

Line Down! Those two words cause more worry to Telephone Engineers than any others.

No matter what the weather, through rain, or sleet, or snow, or ice.

*Creo-pine

telephone, telegraph and light poles give sturdy, dependable service year in, year out.

Through the S. W. P. Vacuum Pressure method of impregnating timber with preservative creosote oils, which we apply only to sound, straight, yellow pine, we produce poles that will withstand all destroying influences of the elements and dreaded powder post insects. Poles treated with creosoted oil have been known to give service for over twenty-five years.

Creo-pine poles will reduce your replacement costs to a minimum. A creo-pine treated pole will outlast many untreated ones. Write today for full information and specifications.

SOUTHERN WOOD PRESERVING CO.
ATLANTA, GA.

Treating Plants EAST POINT, GA., *and* CHATTANOOGA, TENN.

Sales Offices:

NEW YORK · PHILADELPHIA · PITTSBURG · BUFFALO
CLEVELAND · CHICAGO · TOLEDO · CHARLOTTE, N.C.

Animal

Vegetable

Mineral

The silkworm of the animal kingdom, the cotton plant of the vegetable kingdom, and the lead bar of the mineral kingdom—these are typical of the nineteen different raw materials which America's technical genius has compounded into the telephone.

It took three kingdoms ...and one republic

—*to make your telephone*

TO the making of your telephone, Nature's three great kingdoms—animal, vegetable and mineral—have contributed generously. And, to these, the American republic has given of its best inventive vision and work-a-day skill.

This has been an enterprise reaching to the far places of the earth but coming back always to the Western Electric telephone factory at Chicago.

Here precious gold and shining silver are matched in brilliance by the ingenuity that directs their use. Here too age-old traditions in the culture of silk are met by modern methods in the production of the telephone.

In less than half a century Western Electric men have made these methods the standard of the world for telephone making.

Western Electric

SINCE 1869 MAKERS OF ELECTRICAL EQUIPMENT

for Adobe or Baked Clay The MATTHEWS EARTH AUGER

WHEN installing anchors in extraordinarily hard ground or disintegrated rock you will be particularly glad that you are using Matthews Scrulix Anchors. Just bore a small pilot hole with Matthews Earth Auger, then screwing down the anchor is easy. The Auger is so designed that it quickly bores a hole in the hardest kind of adobe or baked clay. Whether it is hard pan or swamp, Matthews Scrulix Anchors are easy to install and hold fast under terrific strain.

W. N. MATTHEWS CORPORATION
3714 Forest Park Blvd. • • • St. Louis, U. S. A.

W.N. MATTHEWS CORPORATION ST. LOUIS, U.S.A. ESTABLISHED 1899

Matthews Scrulix Anchor

Matthews Earth Auger

MATTHEWS SCRULIX ANCHORS

Distributors of Matthews products are located in all principal cities

Send for information on

Matthews Fuswitches
Matthews Disconnecting Switches
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Matthews Adjustable Reel
Matthews Guy Clamps
Matthews Cable Clamps
Matthews Woodpecker Telefault
Matthews Teleheight
Matthews Mechanical Painting Equipment

Matthews Scrulix Anchors are made in 7 sizes. There is a size for every anchor requirement.

36

THE SNOW-MOTOR
FORDSON POWERED

Gets Men and Supplies to Needed Spots When Big Snowfalls Cripple Service

THE Snow-Motor is one of the most important inventions since the telephone itself was given to the world. It is the first practical commercial machine which *provides transportation OVER snow, for all purposes, under all conditions.*

When the furious blizzards of winter rage, with snowdrifts piled high, the SNOW-MOTOR will promptly and easily get linemen and repair materials to crippled poles and down wires. The machine floats OVER snow through which nothing on wheels or horse-drawn sleds can travel. It breaks roads over wildernesses of snow and establishes them so that other conveyances can follow. Cabs to house the driver and one or two other linemen and light supplies can be carried on the machine itself. No longer will it be necessary for telephone companies to struggle with transportation which is incapable of functioning in heavy weather emergencies. The Snow-Motor, by providing dependable transportation OVER snow, brings long wished-for relief to public utility corporations, as well as to many industries whose winter operations have, in the past, been seriously interfered with. *The Snow-Motor definitely meets the situation.*

Rear view of the Snow-Motor showing draw-bar and mechanism for operating the drums.

How the Snow-Motor Works

The Snow-Motor consists of two torpedo-shaped drums or cylinders, to which flanges or spiral runners, resembling corkscrews, are welded. The object of the torpedo-shaped ends of the drums is to press down the snow and prepare the surface for traction. A differential movement of the two rotating drums accomplishes the locomotion. The motive power of the machine is the standard Fordson Tractor. A man driving the Snow-Motor drives it the same as he does an automobile or tractor, using the regular controls. The machine turns on its own center. Any standard Fordson Tractor can be used on the Snow-Motor by removing the wheels and axles, which can be replaced for summer use.

For full particulars see any authorized Ford Dealer, or write to us direct.

Snow-Motors Inc
DETROIT · MICHIGAN · U·S·A

"The Last Link In The Chain of Transportation"

Monarch Cordless P. B. X. Switchboards

Are Made Up In Three Different Combinations Ready For Immediate Shipment

Cordless P. B. X.	Lines Wired	Lines Equipt.	Trunks Wired	Trunks Equipt.	Conn. Circuits Wired and Equipt.
Drg. M-1730-Assm. No. 1	10	10	3	3	5
Drg. M-1730-Assm. No. 2	10	8	3	1	5
Drg. M-1730-Assm. No. 3	10	7	3	2	5

Size of cabinet, 17⅞ in. high, 20 in. wide and 14 in. deep.

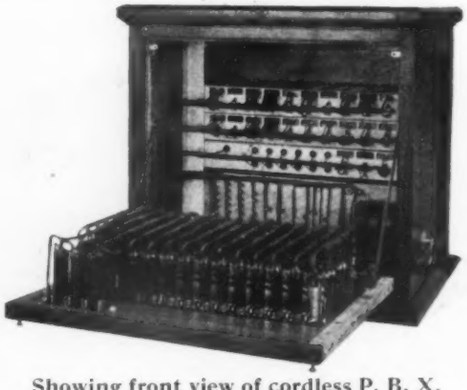
This Monarch Cordless Private Branch Exchange is designed for business houses, offices, or factories that do not require more than 10 local telephones and 3 trunks to the city Main Exchange.

All Incoming trunk signals are received on manually restored drops and visual signals are provided for all local station lines.

On outgoing calls the operator can hold a trunk by means of holding key. Any number of local lines can be connected for group calling or for general alarms.

The Circuits of this P. B. X. Cordless Switchboard are designed to operate in connection with either automatic or common battery manual main exchanges.

This Monarch Cordless P. B. X. Switchboard will be shipped immediately upon receipt of your order. Do your subscribers need a P. B. X. switchboard?

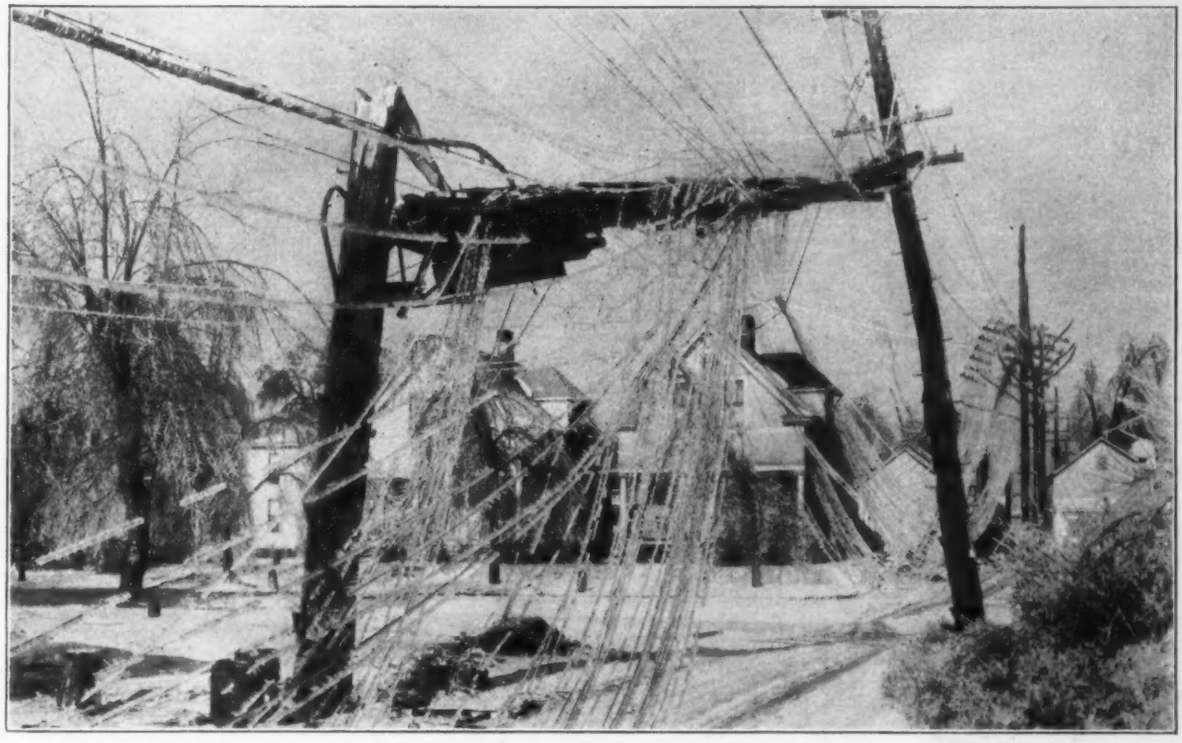


Showing front view of cordless P. B. X. with key panel let down

We are distributors of drop wire, made of COPPERWELD STEEL CO.'S conductor and ELECTRIC CABLE CO.'S high grade insulation.

Monarch Telephone Mfg. Co.

1027 VAN BUREN ST., CHICAGO, ILL.



An Example of the High Cost of Using Untreated Poles

Every winter, snow storms and sleet storms take their toll from untreated pole leads—in the form of costly service interruptions, and new material and labor for replacement.

Last winter, the heavy sleet storm which raged through the middle-west, in December, broke more than 60,000 untreated poles in Illinois, Missouri, Oklahoma and Texas. Reports show that *less than fifty creosoted pine poles were broken during this catastrophe.*

Experiences such as this testify to the economy of using Texas "Black Beauty" Poles, which are select, full-bodied Southern Yellow Pine. This member of the conifer family is endowed with great strength by Nature; and, scientific creosoting under high pressure in our modern and efficient plant makes Texas "Black Beauty" Poles immune to the attack of the forces which cause decay and loss of bearing strength.

Put Texas "Black Beauty" Poles in your line! They are real service insurance against interruptions and replacement costs—and they serve for generations.

We have a large stock of fine poles on our sand-filled yards. Let us quote on your requirements.

2T5

The Mark of Quality in Creosoted Materials

TEXAS CREOSOTING COMPANY

Main Office and Plant: Orange, Tex., U. S. A.

MONARCH TELEPHONE MFG. CO., Agents

CHICAGO, ILLINOIS

Texas "Black Beauty" Poles

COLUMBIA
TRADE MARK REGISTERED
GRAY LABEL
DRY CELL
FOR TELEPHONE
SERVICE
This dry cell combines both quality and service in the highest degree. Its quick recuperative power guarantees the greatest efficiency, reliability and long life for telephone use.
NATIONAL CARBON CO. Inc.
NEW YORK, N. Y.
ATLANTA, CHICAGO, CLEVELAND
KANSAS CITY, LONG ISLAND CITY, SAN FRANCISCO
MADE IN U.S.A.
© 1923 N.C. CO. INC.
POSITIVE TERMINAL IN CENTER

COLUMBIA Gray Label Batteries are especially built for the exacting requirements of telephone service—sharp, high work peaks; long, low valleys of rest. On the closed circuit they are alert, vigorous, vigilant. On the open circuit they sleep quietly, dreamlessly; no muttering, no corrosive wastefulness. Great endurance for long calls, strength that keeps itself under complete control when idle.

Because they save their energy for useful work, Columbia Gray Label Batteries cost less per month of service. Fahnestock spring clip binding posts at no extra cost to you.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

Columbia Telephone Batteries

Best by Test—They Last Longer

Here's a High-Class Telephone Test Set

PEERLESS

It's called the T-2002. It is built for Independent telephone companies, and is the outgrowth of years of experimenting and usage, under the most exacting conditions.

T-2002 is not to be confused with cheaper make-shifts any more than a big, reliable radio could be classed with a home-made set. T-2002 is a high grade instrument of known value, put out by a responsible house.

It is extremely simple, yet practically unlimited in its uses. And, notwithstanding all of these important advantages, it sells at a very reasonable price.

Our line also includes Portable Testing Sets, Cable Testing Apparatus and Standard Electrical Instruments. Or, we'll make up anything special that anyone may need or contemplate in the telephone field.

If you have a new idea or patent that you wish to put on the market, get a manufacturing proposition from us. We have a large and modern establishment manned by experienced specialists.

Thompson-Levering Co.
351-361 North 57th Street
Philadelphia, Pa., U. S. A.

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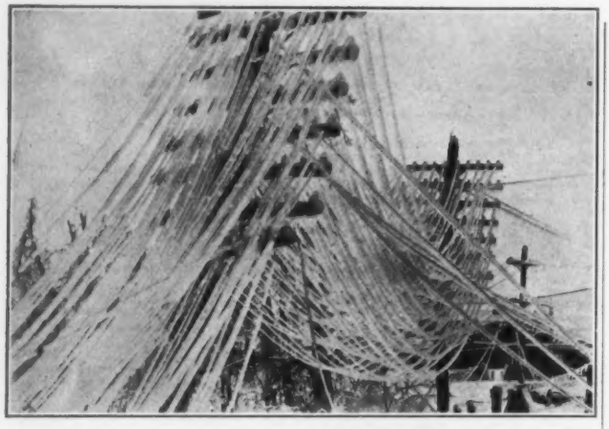


SLEET *and* WIND HOLD NO TERROR

for

ARISTOS **"COPPERWELD"** WIRES

Made by the Molten Welding Process

75% safer, size for size. Copperweld wires "ride thru' the storm." They **stay up** after copper and (new) galvanized wires of equal and larger sizes are down.

Copperweld wire **does not rust.** The copper exterior is **permanently welded** to the steel core for all time to come. It can never crack, split or peel.

Copperweld wire **costs less per mile** than copper or galvanized wires of equal and less safety—safety being based on ability to withstand sleet and wind loads. Copperweld wire also weighs less and is easier to string.

COPPERWELD TELEPHONE WIRE and TWISTED PAIR are sold by

KELLOGG SWITCHBOARD & SUPPLY COMPANY
CHICAGO, ILL.
Columbus, Ohio — Kansas City, Mo.
San Francisco, Calif. — Portland, Ore.

Monarch Telephone Mfg. Co.
1027 WEST VAN BUREN ST., CHICAGO, ILL.

Copperweld Steel Company
MAIN OFFICE & MILLS:-BRADDOCK P.O., RANKIN, PA.
30 CHURCH ST., NEW YORK. 129 S. JEFFERSON ST., CHICAGO
403 RIALTO BLDG., SAN FRANCISCO

There is no other "copper-covered steel" or "copper-clad steel" made like "COPPERWELD"—by the Molten Welding Process.

Sterling Is Always Sterling

Even to the third and fourth generations sterling ware is as brilliant, as beautiful and as useful as the day it was bought. The sterling mark assures forever the intrinsic value that only sterling has.

The trademark on French Telephone Batteries—Mister Ray-O-Lite—insures the highest quality which engineering science has thus far been able to build into a battery that meets every requirement of telephone service. It is a uniform quality for which hundreds of telephone executives have made French Batteries the standard equipment on their lines.

Also makers of French Ray-O-Vac Batteries. 11 models cover every radio use.

FRENCH BATTERY COMPANY
Madison, Wisconsin

Atlanta Dallas Denver Kansas City
Chicago New York Minneapolis

FRENCH TELEPHONE BATTERIES

RUNZEL-LENZ ELECTRIC MFG. CO.

Specialists in the
manufacture of

CORDS

for

TELEPHONES

and

SWITCHBOARDS

A R-L cord to fit any make of
telephone or switchboard

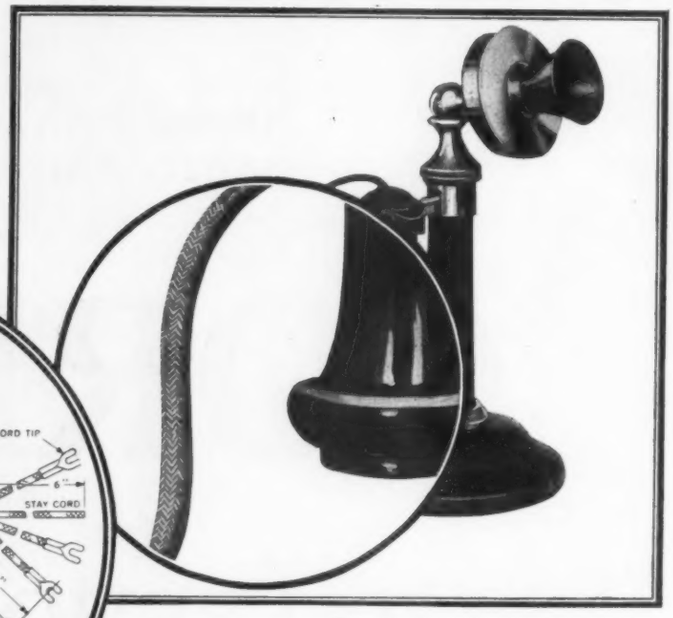
RUNZEL-LENZ
ELECTRIC MANUFACTURING CO.

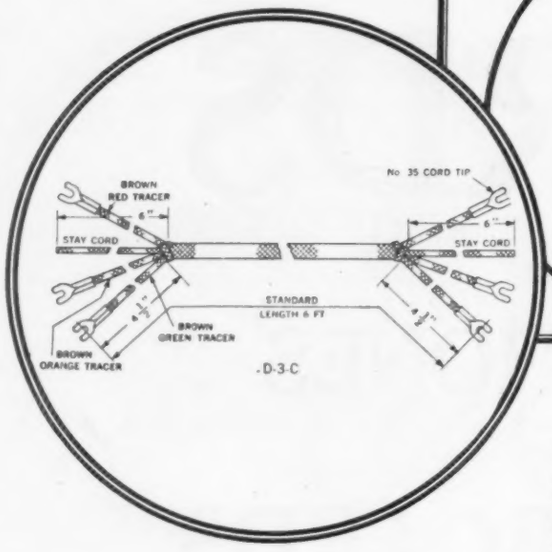
1751-57 North Western Ave. CHICAGO

DEPENDABLE SINCE 1904

Stromberg-Carlson

The illustration shows the Stromberg-Carlson No. 986 Desk Stand, an enlarged view of the R-2-G Duratex, brown, silk receiver cord and a diagrammatic view of the No. D-3-C Duratex desk stand cord.





The Stromberg-Carlson No. 986 Desk Stand is equipped with "Duratex Brown Silk Cords."

The Stromberg-Carlson No. 986 Desk Stand is equipped with "Bakelite Parts."

The Stromberg-Carlson No. 986 Desk Stand is equipped with a "Highly Efficient Transmitter."

The Stromberg-Carlson No. 986 Desk Stand is equipped with "Booster Talking Circuit."

The Stromberg-Carlson No. 986 Desk Stand is furnished with desk set boxes of the "Concealed Gong" type.

DURABILITY

Years ago the desk stand was not in favor with many telephone managers. Those men looked upon the desk stand as expensive to maintain as compared with the wall telephone.

Then, desk stands were, as they are today, subject to tumbles, and twists unknown to the wall telephone. The tumbles in olden days were sure to mean broken ear caps, broken receiver shells and broken mouth pieces. But today, tumbles are not so expensive, thanks to the tough Bakelite parts.

And twists in olden days meant damaged cords. They meant cords which were not only full of kinks and noise but often wide open. Today twists like tumbles are not so expensive. For today telephone men can equip their desk stands with Stromberg-Carlson Duratex cords. This is the cord furnished with the No. 986 Desk Stand. It is the moisture-proofed, bronze alloy cord which is built to give years and years of good service.

Duratex cords are as superior to ordinary tinsel telephone cords as Bakelite is to ordinary composition.

Stromberg-Carlson Telephone Mfg. Co.

FACTORY and GENERAL OFFICES—ROCHESTER, N. Y., U. S. A.

BRANCH OFFICES:

CHICAGO, ILLINOIS **KANSAS CITY, MISSOURI** **TORONTO, CANADA**

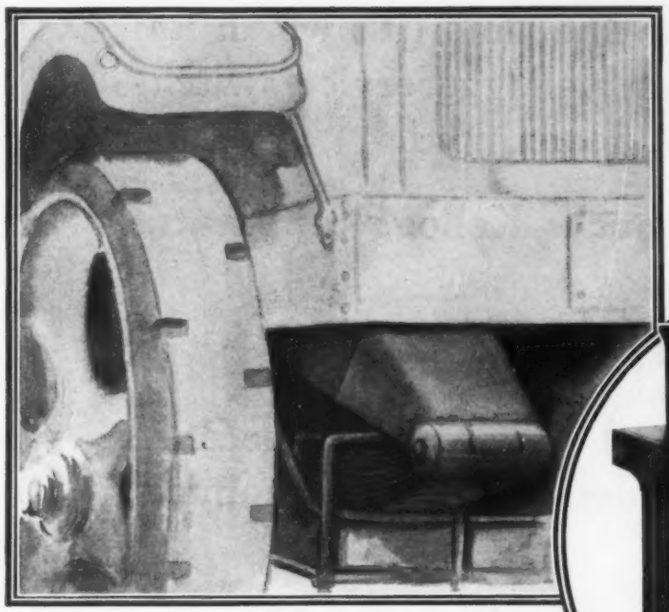
DISTRIBUTORS:

Garnett Young & Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore., Seattle, Wash.
Scoville Mercantile Company, Atlanta, Ga.

JOBBERS:

Midland Electric Company, Regina, Sask.
Charleston Electrical Supply Company, Charleston, West Virginia

Stromberg-Carlson



The illustration shows the rear of a Stromberg-Carlson No. 102 P. B. X. Switchboard with the gate swung open.

FLEXIBILITY

The flexibility of the truck's spring smoothes out the high spots in the road. In like manner the flexibility of the Stromberg-Carlson P. B. X. Switchboard smoothes out the high spots in traffic requirements.

More lines or fewer lines, more trunks or fewer trunks, more cords or fewer cords, such changes are easily and quickly made to satisfy traffic requirements. Stromberg-Carlson P. B. X. Switchboards are noted for their flexibility.

Stromberg-Carlson P. B. X. Switchboards have the following features:

A High Wound Relay in Every Line, Trunk Circuits with Universal wiring adapted to connect with central energy exchanges, magneto exchanges, automatic exchanges, short trunk lines or long trunk lines.

Removable Trunk Circuit Plates

A Horizontally Swinging Relay Gate

Keys Mounted Flush on Steel Frames

A Flexible Transmitter Suspension

A Low Keyboard, 31 Inches High

The following standard equipments are recommended:

No. 101 P. B. X. Switchboards wired for 50 lines, 8 cord pairs and 5 trunks.

Code No.	Lines Eqpd.	Cords Eqpd.	Trunks Eqpd.
101-A	10	4	2
101-B	20	4	3
101-C	30	5	3
101-D	40	6	4
101-E	50	8	4

No. 102 P. B. X. Switchboards wired for 100 lines, 10 cord pairs and 7 trunks.

Code No.	Lines Eqpd.	Cords Eqpd.	Trunks Eqpd.
102-A	10	4	2
102-B	20	4	3
102-C	30	5	3
102-D	40	6	3
102-E	50	8	3
102-F	60	8	3
102-G	70	8	4
102-H	80	10	4
102-I	90	10	4
102-J	100	10	5

Stromberg-Carlson Telephone Mfg. Co.

FACTORY and GENERAL OFFICES—ROCHESTER, N. Y., U. S. A.

BRANCH OFFICES:

CHICAGO, ILLINOIS KANSAS CITY, MISSOURI TORONTO, CANADA

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Scoville Mercantile Company, Atlanta, Ga.

JOBBERS:

Midland Electric Company, Regina, Sask.
Charleston Electrical Supply Company, Charleston, West Virginia

But—Then—Take the time (it's worth it!) and go to a number of Kellogg Service switchboard exchanges. Get acquainted.

Find out how much Kellogg apparatus really pays!

That's what we're all in business for.

You'll go home and buy Kellogg, because it gives an efficient, dependable, economical service.

It's built that way. Has been for 28 years. It's part and parcel of the Kellogg ideal, and Kellogg policy to build right. It costs more, but it works right and lasts longer.

Get apparatus that pays and it will pay you.

Take Kellogg exchanges throughout the country. They pay. They have the best.

With every Kellogg switchboard,

Use—Is The Test

KELLOGG SWITCHBOARD & SUPPLY COMPANY

CHICAGO, ILLINOIS

COLUMBUS, OHIO. 163 N. Fourth St.

KANSAS CITY, MO. 308 W. 6th St. Traffic Way

PORTLAND, ORE. 383 E. Burnside St.

SAN FRANCISCO, CAL. 1054 Mission St.

How About 1926?

Is your exchange reaching the point where a new switchboard, of greater efficiency and greater capacity is needed?

It takes time to properly investigate and study the kinds of switching equipment that may fit your needs.

With all the problems and special conditions which the telephone company must overcome--- the very best switching equipment, as well as the most efficient management available, is necessary, if dividends are to be expected.

We ask you to study most carefully all types of switchboards as to practicability, economy, speed, long life and popularity of service.

Find out about first cost, peak load handling, maintenance, operating costs.

Contact Points–Plus

IT IS no exaggeration to say that wherever a contact point controls the operation of any machine, it is the most important single unit in the mechanism. Until it functions, the other parts are just so much inert material. Too much care, then, cannot be devoted to its design, to the alloy of which it is made, to its form and shape and size.

We Can Help You Very Much

We have been making contact points for fifty years, experimenting with them, formulating scientifically correct special alloys, adapted to certain types of service. These alloys endow the contact point with ability to deliver the maximum, both in efficiency and durability. Such understanding of the subject cannot be acquired in one decade nor in two. It is the accumulated knowledge of half a century, and it is yours to draw upon, at will.

Test it before you order again.

BAKER & CO., INC.

Platinum—Gold—Silver

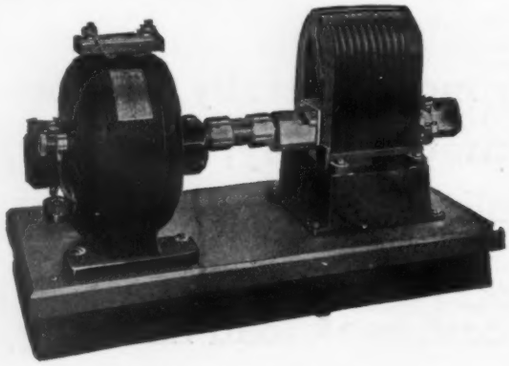
54 Austin Street, Newark, N. J.

30 Church St., New York **5 So. Wabash Ave., Chicago**

Good Ringing Service

Have you got it in your exchange? There is only one really dependable way, and that is by installing a

HOLTZER-CABOT
MAGNETO-RINGING MOTOR-GENERATOR



Write us about your ringing troubles. We are glad to offer you real service and advice before you buy. Our motor-generator will give you the service after you have bought.

The Holtzer-Cabot Electric Co.

125 Amory St., Boston, Mass. **6161 So. State St., Chicago, Ill.**

EVER-PROTECT Usefulness Is Extended

EVER-PROTECT
CABLE COMPOUND
TRADE MARK REG. U.S. PAT. OFF.

You know what Ever-Protect cable compound already has done in bringing practical installations of cable underground without conduit within the reach of every telephone company's construction budget. It put an end to cable corrosion, electrolytic action, abrasion and chemical action.

Now you can get more value from Ever-Protect because it is available in LIQUID form. So you can use Ever-Protect on aerial cables, messengers, laterals and roofs of poles, from now on with the utmost of convenience and thrift. Liquid Ever-Protect is easily applied and stays **flexible.**

Investigate at once this enlarged field for the saving that Ever-Protect Cable Compound makes possible to the alert telephone man.

Get complete details of Ever-Protect Cable Compound, regular or liquid, from your nearest jobber, or write us.

National Cable Compound Company
(Incorporated)
Mitchell, Indiana

CONVERTIBLE DESK AND WALL TELEPHONES

FOR COMMON BATTERY AND AUTOMATIC SYSTEMS

No. 114 Desk Set

Convertible Telephones

For Common Battery exchanges where a possible future change to automatic system is contemplated, it is a wise foresight on any telephones needed in the meantime to purchase these convertible types. The instruments here illustrated show many clever features of construction and adaptability to either system.

Automatic Dial

Any make of dial can be connected and mounted in a few seconds—on desk stand the dial is well over the center of the base, safe from knocks or damage.

No. 166 Wall Type

Neat, pleasing design. Double door steel cabinet—enclosed ringer gongs, safe from tampering. Slotted openings in the cabinet make the ringing of the gongs clearly audible. High efficiency transmitter and receiver. Adjustable transmitter mounting.

No. 114 Desk Set

Note simplicity of switch-hook construction. Stand with or without dial. Furnished with new enclosed gong bell box No. 167, similar in construction to the No. 166 wall telephone. Burns Rubber Ring on base prevents slipping of phone when dialing.

Accessibility — Standardization

Every part of these instruments is instantly accessible. Ringer adjustments can be easily made and permanently locked. **Large Booster induction coil.** Substantial removable switch-hook. Convenient line terminals.

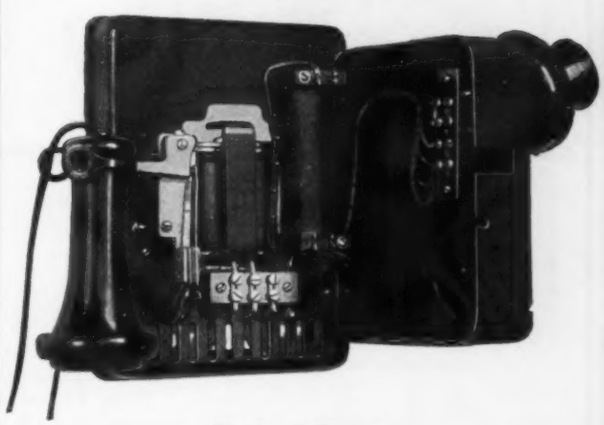
American Electric

COMPANY

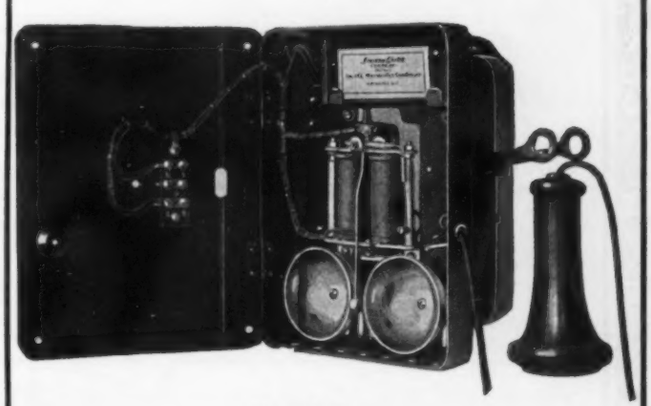
For Thirty Years Makers of Good Telephones

CHICAGO, U. S. A.

No. 166 Wall Set



Enclosed Gongs



Slotted Case

Let us furnish estimates and full data for your consideration

FULL LINE OF TELEPHONES AND SWITCHBOARDS

TELEPHONE ENGINEER, December, 1925. Volume 29, No. 12. Published monthly by TELEPHONE ENGINEER. Publication Office, 28 E. Jackson Blvd., Chicago, Ill. Subscription price $2 a year in the U. S. Entered as second class matter June 6, 1922, at the Post Office at Chicago, Ill., under act of March 3, 1879.

DEC 18 1925

TELEPHONE ENGINEER

VOL. 29, No. 12 DECEMBER, 1925 CHICAGO

When Business Men Use The Telephone

WHAT your business subscribers think of the service you give them is of vital importance to the welfare of your company. No other class of subscribers appreciate speed and accuracy so much. Free them forever from little irritating delays and errors, and you can get their hearty co-operation in any project you may wish to undertake.

In all cities where the Strowger Automatic system is used, business men are invariably enthusiastic over their telephone service. They like its accuracy, its unfailing readiness to serve, its impersonality, and the quick, positive response to every number dialed.

When you need new capital for extensions, or an increase in rates, you will find the good will of your business subscribers indispensable.

Strowger Automatic service will gain their co-operation quicker than anything else.

STROWGER AUTOMATIC

Automatic Electric Inc.

Factory and General Offices: 1033 West Van Buren Street
Chicago, Illinois

TABLE OF CONTENTS AND INDEX TO ADVERTISEMENTS, PAGE 10

Brand And Solder The Everhot Way

Don't confuse the Everhot Combination Outfit with any other branding iron. The Everhot stays hot and brands continuously—no waiting to reheat. The torch, which is attached, keeps the brand hot for hours of continuous service. Here is a real combination outfit that can be used not only for branding purposes but also as a torch and soldering iron.

Use the Everhot for branding your new poles and crossarms while they are in the yards, as well as for branding your standing poles. Branding your poles in the yard protects you against confusion as to ownership when they are delivered ready to raise. At the same time it marks your poles for future identification. The company name and identification number branded into these poles make it easy to issue working orders, telling linemen just where to make repairs.

Use the Everhot also for burning the proof of your ownership into all your working tools and equipment. Tools marked in this way do not mysteriously disappear. They remain your property until they are worn out.

The fuel—ordinary gasoline—is in the handle, and the torch is ready to use anywhere—any time.

Write for low prices and details.

EVERHOT
America's Brand Makers
MANUFACTURING CO. MAYWOOD, ILLINOIS

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Central Accounting Department
Keeps the records and makes up all reports for companies (large and small) in 17 states. The cost is about half the salary of a bookkeeper. It will not cost you anything to inquire as to our plan, charges, etc. Write today.
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Highest prices paid for discarded or obsolete telephone and switchboard apparatus; platinum contact relays, ring keys, etc. Have specialized in this field for many years.
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Universal Specialty Company
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Cleveland, O.—The Premier Handy department of the Electric Vacuum Cleaner Co., is presenting to the telephone industry, new tool equipment for its Premier Handy telephone vacuum cleaner. This tool equipment includes various bristle brushes, a rubber tool with circular opening, a longer and more pliable hose, shoulder and belt straps, and also a shield for the operator. The cleaner itself is now constructed in ball-bearing mounting, the suction has been increased, the size of the bag has been increased for greater filtering area, and a fibre bag clamp is used in place of metal.

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Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies.
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J. K. Johnston, Telephone Engineer
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A SUBSTITUTE FOR A WIPED JOINT. NOT A SPECIAL SLEEVE

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Capacity ..... Address .....

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Stewart Test Cabinet

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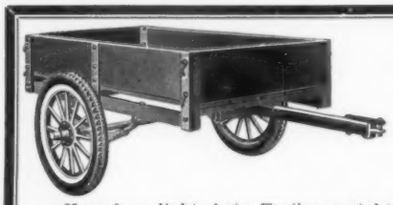
Sent on 30 days' trial.

STEWART BROTHERS

Makers of Testing Instruments

OTTAWA, ILLINOIS



AUTO TRAILER

$39.00

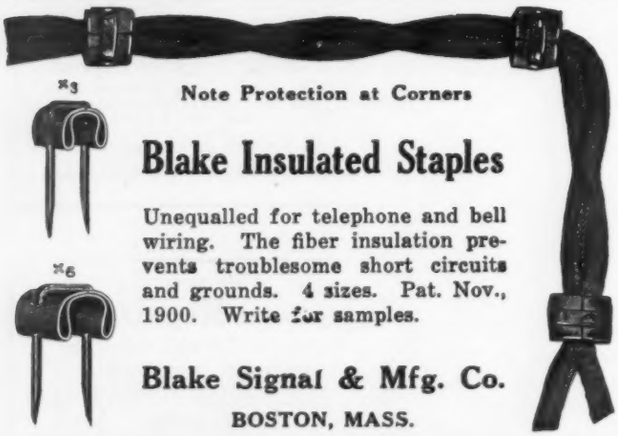
Here is a light Auto Trailer, weight 275 pounds, with a carrying capacity of 1,000 pounds. Sizes of body, 40x72 inches; 12 inches high. The wheels, hubs, bearings, springs and spring shackles are interchangeable with the Ford car.

Price does not include pneumatic tires. We do not furnish or handle any tires, most customers prefer to furnish their own. The wheels are regular Ford clincher 30x3½.

With sheet of illustrated instructions furnished it is easy to have your local garage or machine shop make up and attach a bracket to any make of automobile to hitch the trailer to.

THE BOWER MFG. CO.

FOWLER, INDIANA, BOX 99



Note Protection at Corners

Blake Insulated Staples

Unequalled for telephone and bell wiring. The fiber insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for samples.

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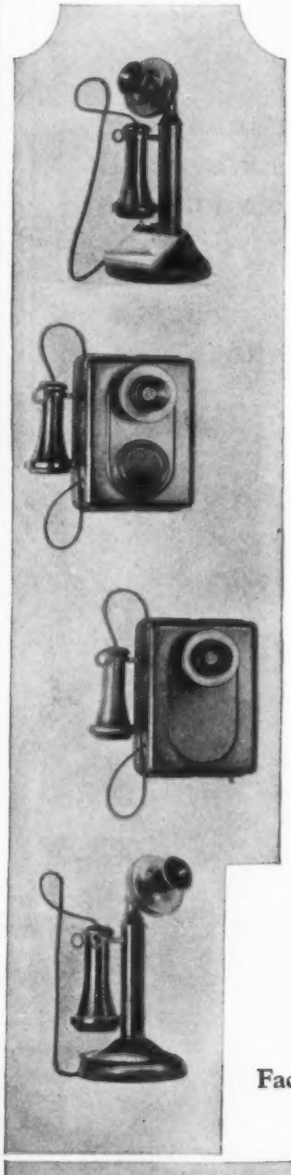
STROWGER AUTOMATIC

Compare These Telephones With Those You Are Now Using



MAKE a definite point-by-point comparison between these Type 21 Common Battery Telephones and any type of telephone you are now using or can secure. Investigate carefully as to durability, quality of workmanship and material, ingenuity of design, convenience of operation, and quality of transmission. We believe you will agree that they represent a standard of development hitherto unattained in telephone instrument design.

Type 21 Telephones incorporate in their construction the best of the many improvements which the past few years have witnessed, together with some new and distinctive ideas that are peculiarly their own. Telephone users are as quick to appreciate their beauty and convenience as operating men are to value their durable finish and construction.

Type 21 Telephones can be furnished for either manual or automatic service, and for any standard type of common battery circuit which may be required to fit your individual needs. They are available with or without dials, or fitted with dial blanks or writing pads for future automatic service.

Write for Prices and New Descriptive Booklet, "The Telephone Book."

Automatic Electric Inc.

Factory and General Offices: 1033 West Van Buren St Chicago, Illinois, U. S. A

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A Style for Every Type of Service

The Never-Creep "convincers"

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Use a few of them where anchors get the most severe tests and eventually you will standardize on Never-Creep.

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